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ARCHEOLOGY.—*Florida archeology and recent ecological changes.*[1] JOHN M. GOGGIN, Peabody Museum of Natural History, Yale University. (Communicated by W. R. WEDEL.)

American archeology in the past few years has turned to several of the natural sciences for aid in dating recent sites and for a fuller understanding of the natural environment in which primitive man played his role. In the Southwest, for example, archeologists have been able to obtain calendric or absolute dates from the study of tree rings (Glock, 1937; Haury, 1935). Pollen analysis, of considerable value in European prehistory, also shows promise of utility in the New World (Sears, 1937). Other methods of dating and interpretation are based upon work done by the geologist and conchologist (Baker, 1937; Richards, 1937).

The best results are now being obtained by cooperative research on the part of both archeologists and natural scientists. Two such studies can be briefly summarized: One in Oregon gave a relative date for archeological material sealed in a cave deposit under volcanic ash. The same ash layer was found in peat deposits. By pollen analysis the history of the peat deposit was worked out, and the relative date of this ash layer was determined, which in turn gave an upper limit relative date for the archeological material in the cave.[2]

Another recent example of a combined project of this type is the Boylston Street fishweir. In the course of a construction excavation in Boston the remains of a fishweir were found many feet below the present surface of the land. The indications are that man lived in the Charles River estuary "when the level of the sea in relation to land, was about fifteen feet eight inches lower than it is at the present time" (Johnson et al., 1942). A more recent joint problem of archeology and botany is the Grassy Island site (Johnson and Raup, 1947).[3]

Approaches like these were originally developed in the Old World where the usual time span involved was much greater.[4] Although American archeologists had been aware of the European results, it was thought until recently that the length of time in which the greatest developments in American cultures took place was too short to have resulted in ecological changes of any importance. It is now realized that while the changes that have taken place in the New World are not so sharp as those in some parts of Europe, such as in Scandinavia, nevertheless they are present and can be detected by more refined analysis.

[1] Data used in this paper were gathered as part of the Yale Caribbean Program directed by Dr. Cornelius Osgood. The 1947 summer's work was done under a fellowship from the Social Science Research Council. Many persons have been very helpful in offering me unpublished data, especially Irving Rouse, Vera M. Masius, and John W. Griffin. Others have generously read and criticized the manuscript. For this special thanks are due Frederick Johnson, R. S. Peabody Foundation, Phillips Academy, Andover, Mass.; Irving Rouse, Department of Anthropology, Yale University; Richard F. Flint, Department of Geology, Yale University; and Martin Burkenroad Newport, North Carolina. Received March 22, 1948.

[2] *Symposium on Early Man in Oregon*: Cressman, 1946; Hansen, 1946; Allison, 1946. Hansen, 1947.

[3] As a point of historical interest it can be noted that E. S. Morse was perhaps one of the first to point out a series of ecological changes in vegetation, species of animals, and erosional factors in a single Maine shell heap (1868; 1925: 430).

[4] A complete summary of the methods and results of archeological and geological dating will be found in Zeuner, 1946.

The twofold problem facing the archeologist can be briefly summarized as follows: The first phase will necessitate the preparation of a detailed ecological history of late Pleistocene and Recent times covering the climate, the composition and changes in flora and fauna, and the changes in land form, especially the coast line. These are factors directly affecting primitive man on a simple subsistence level. The second problem, of special interest to the archeologist, is whether any of these changes can be used for either absolute or comparative dating. A hope for absolute dating possibly lies in the analysis of some constant process such as tree rings or the deposition of sediments like varves or peats, and less likely in sea-level changes. But sea-level changes, as well as ecological changes, do offer hope of comparative correlations with other regions where similar conditions can be observed.

The analysis of climatic fluctuations with the attendant floral and faunal changes also offers much hope for comparative correlations. This should be especially helpful in Florida where a relatively sharp temperate versus tropical physiographic line can now be drawn. Minor climatic changes, only scantily reflected in either more temperate or tropical regions, probably resulted in appreciable movements of the border line in Florida.[5] This meant that abrupt changes often took place in Florida, which necessitated adjustment of the biota to the new conditions.

In the course of recent archeological work in Florida the writer has noticed a number of situations that may offer valuable information if they can be considered in detail by competent specialists. It is the object of this paper to bring these situations to the attention of the respective specialists in the hope that they may be stimulated to follow up some of the problems, or to instill an awareness of the problems in event that similar situations arise in routine biological or geological research. Some of the following situations have been directly observed in the field and others are taken from existing literature. In most cases there is not enough information to formulate concrete conclusions. They must be thought of as interesting leads offering promise with future detailed work.

No attempt has been made to gather similar data from purely natural-history sources or to evaluate the material presented here in terms of other ecological data. To repeat, it is the purpose of this paper to present evidence of ecological changes that can be related to human activity in this region for dating purposes. An explanation of the various archeological cultures referred to in this article will be found in a recent paper (Goggin, 1947). A chronological chart from that paper is reproduced here (Fig. 1).

Changes in sea level.—Careful measurements in recent years have brought forth data on the rise of sea level relative to a stable coast line (Flint, 1947: 426–428). In south Florida this rise has been demonstrated by Davis (1940: 402–405; 1946: 180–181) in his study of the mangrove swamp.

It is of interest therefore to be able to correlate this rise in sea level with sites occupied by man. Numerous midden sites in southern Florida, particularly those on the lower east coast, in the Ten Thousand Islands, and in the Cape Sable region, which are now small islands in the mangroves, were probably on dry land when first occupied. A good example is one located in the present village of Surfside north of Miami Beach. This site consists of a black dirt and shell midden with an adjacent burial mound made of beach sand. The midden site was first occupied in Glades II times, but the burial mound is believed to date from Glades III times (Fig. 1). Previous to the filling operations the site was a small dry, hammock-covered island in the mangrove swamp.

Excavation in the burial mound has revealed the lowermost group of human bones to be completely below low tide level. No mangrove peat underlies the mound. It is

[5] It is probably no accident that the bulk of the comparable data for ecological changes in Eastern United States, mentioned in later sections of this paper, comes from Maine. This too is a physiographic boundary area and climatic variances would make appreciable changes here as in Florida. An area in the middle of a large physiographic region, Virginia for example, would not be affected by variances which would result in pronounced changes in Florida or Maine.

very unlikely that the burials were made under water and then covered with sand; therefore the sea level must have risen since the burials were deposited. This postulation is substantiated by trenches in the midden part of the site, which show that deposit to be resting on clean beach sand, not mangrove peat.

A reconstruction of the history of the site would be as follows: The first occupation here was on the dry inner shore of the beach ridge. Subsequently the rise of sea level inundated the low shoreline and isolated the site, which by that time had been built up enough to be above the rising sea. Thus the site became an island which in time was surrounded by a mangrove swamp.

Changes in ground-water level.—In parts of southern Florida there has been an appreciable demonstrable rise in ground-water level, which is in some places associated with a deposition of sediments.

South Indian Field is a sand midden site in the valley of the St. Johns River near its head, west of Malabar, Brevard County. This little cabbage-palm hammock is a mound composed of sand and refuse about 3 feet higher than the surrounding sawgrass prairie (Rouse, MS.). Previous to modern drainage water normally surrounded the site, and often only the constricted highest portions were above water.

Excavations in the site (Masius, MS.) indicate that the first occupation began here on a level approximately the same as the present surface of the prairie. As refuse accumulated the site was built to its present height. In terms of the archeological picture this site was fairly early, its initial occupation in the Orange Period being about 700 A. D. or earlier (Fig. 1).

An interesting problem is posed here (Rouse, MS.). In the light of recent conditions, the earliest level of the site could not have been a suitable camp site for the Indians, for it was never dry enough. Even

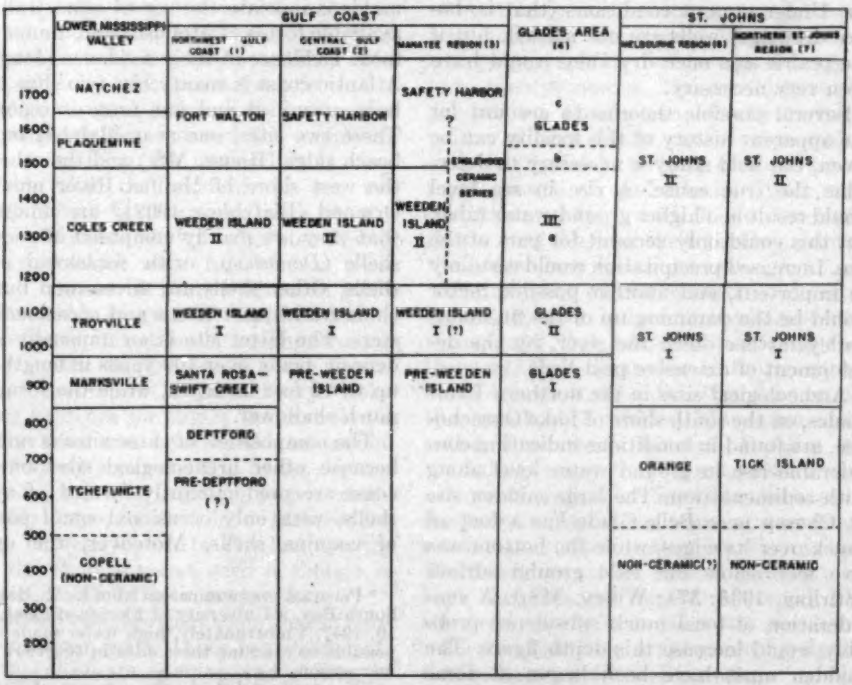

FIG. 1.—Archeological areas and periods in Florida. The term "Archaic Horizon," as used in the text, refers to the Orange, Tick Island, and Nonceramic periods.

a short seasonal dry spell or several years of drought would not have given a sufficient period of time for the beginnings of the midden, as the deposit shows no signs of a rapid accumulation which might have enabled its builders to get above the present water level. Therefore, we have to postulate a different initial ecological condition, one in which the prairie was completely dry. Since that time the water table has risen and the surrounding area become a marsh.

As corroborative evidence for the dryness of the locality Rouse (MS.) has noted that the present surface material of the prairie is sand, but until recently there was a thin layer of muck or peat, which has burned off since drainage. There is no muck under the refuse deposit; so such material must have formed since the development of the site. In addition there are traces of a large number of pits which were dug around the site during the early period of occupation. They seem admirable wells, but otherwise their presence is difficult to account for. Under present conditions (that is, before drainage) wells are not needed, but if the prairie was once dry they would have been very necessary.

Several possible theories to account for the apparent history of this locality can be given, but field study is necessary to determine the true cause. A rise in sea level would result in a higher ground-water table, but this could only account for part of the rise. Increased precipitation would certainly be important, and another possible factor would be the damming up of the St. Johns Valley farther down the river, by the development of extensive peat beds.

Archeological sites in the northern Everglades, on the south shore of Lake Okeechobee, are found in conditions indicating considerable rise in ground water level along with sedimentation. The large midden site at Chosen near Belle Glade has a foot of muck over its edges, while the bottom was two feet below the 1934 ground surface (Stirling, 1935: 374; Willey, MS.). A consideration of local muck subsidence probably would increase this depth figure. The midden must have been begun at some period of low water when the Everglades were dry or nearly so, possibly at one of the low water stages indicated by Dachnowski-Stokes (1930).

At South Bay, to the west of Belle Glade, even deeper archeological sites have been reported.[6] These are small midden deposits with animal bones and pottery which lay about three feet below the present surface of the muck. A number of these have been noted in the sides of drainage ditches in this region. All appear to be on the same stratigraphic horizon. The reported two-foot subsidence in this region gives an original depth of five feet for these small sites. Like the Belle Glade site, they could not have been formed under anything similar to the modern predrainage conditions, but must have been begun at a relatively dry period.

Changes in local ecology.—There is some archeological evidence that coastal lagoons such as the Indian River and Halifax River were once much fresher than in recent years.

The Florida Archaic peoples, using fiber-tempered pottery, lived mainly along the St. Johns River, where their large shell middens indicate the use of almost all the available forms of Mollusca and animals for food. Evidence of their residence along the Atlantic coast is scanty but two sites have been examined and one more is reported. These two sites, one near Malabar on the beach ridge (Rouse, MS.) and the other on the west shore of Halifax River north of Ormond (Blatchley, 1902),[7] are unique in that they are mainly composed of coquina shells (*Donax* sp.) with occasional moon shells. Other shells are uncommon but include fresh-water forms and occasional oysters. The latter site is an unusually large deposit, being over 100 yards in length and up to 12 feet in depth, while the former is much shallower.

The composition of these sites is unusual because other archeological sites on this coast are predominantly formed of oyster shells, with only occasional small pockets of coquina shells. Moreover, the oyster

[6] Personal communication from L. M. Hardy of South Bay, a University of Florida student, July 10, 1947. Unfortunately, high water made it impossible to examine these sites in the 1947 summer season.

[7] Excavations here in the summer of 1947 by the Florida Park Service will give us much more data when the results are studied.

shell heaps are all of the St. Johns I and II periods dating from a later time (Fig. 1). Therefore, the difference in composition of these sites has temporal significance.

It seems probable that if oysters were available in quantity they would have been eaten by the Archaic peoples. They certainly showed little selectivity for foods on the St. Johns, and the occasional oyster shell in the coastal middens indicates that they were used when available. Under present ecological conditions (before dredging) and for some time previous, judging from the St. Johns I and II shell heaps, oysters were abundant in the coastal lagoons. By inference from their absence in the early sites, it seems probable that at the time these middens were deposited oysters were not available in quantity.

A successful oyster habitat is one that has the proper concentration of brackish water; therefore oysters usually grow in large bays and estuaries where fresh water constantly mingles with salt water. If this proper habitat was not available in Archaic times then the water must have been either too fresh or too salty. The possibility of its being too salty is not so probable in view of the lower sea level, unless there was a period of drought which reduced the supply of fresh water from the interior. It is more probable that the level of the sea was enough lower (perhaps no more than a couple of feet) to allow fresh water or only slightly brackish water to stand in these shallow lagoons. A similar situation could be the result of greater runoff, from increased precipitation, in the feeding streams. However, the shallowness of these coastal lagoons favors the former theory. Reinforcing evidence for this is the fact that a slightly lower sea level would be accompanied by a steeper gradient in the streams emptying into the lagoons, which would probably have resulted in a greater discharge of fresh water. In this flat country with the short streams such a change in gradient would be of importance.

Another possible explanation for the freshness of lagoon water takes into consideration the alternate opening and closing of inlets along the coast. This is an observed situation noted from the late eighteenth century (Romans, 1775: 287) to the present. However, inlet closing would produce purely local phenomena while we are dealing with areas as far apart as Ormond and Malabar, but which appear to share the same ecological situations.

Another possibility, which seems least probable to the writer, is that there was little or no change in depth and salinity of the coastal lagoons and that the absence of oysters must be due to other causes. In event of such a situation the possibility of some catastrophe killing the oysters cannot be ignored. Cold waves, salinity changes, and micro-organisms are known to have caused much damage among fish, although the damage to invertebrates is not well known (Gunter, 1947). Such disasters would be much more severe in the coastal lagoons than along the open Atlantic. Thus Mollusca such as the coquina would be less damaged.

It has been suggested (personal communication, Martin Burkenroad, January 1948) that considerable time might have been necessary after the water had reached the proper salinity before oysters would have been numerous. This would have depended on the nature of the bottom; neither a very sandy nor a very muddy situation would have been conducive to a rapid growth of oyster beds. Under such conditions they would have developed slowly until the dead shells finally produced the proper base for an extensive growth.

In summary we can reconstruct the situation as follows: In late Archaic times—the Orange and Tick Island periods (Fig. 1)—there was little occupation of the north Atlantic coast of Florida. The few people there made shell middens of coquina shells gathered on sandy beaches. Because the coastal lagoons were too fresh, oysters were not common. In a few localities, perhaps at the mouths of inlets, some oysters were available and these were eaten when found. The freshness of the coastal lagoons may have been due to a number of factors, but the most probable is the lower sea level, with the possibility of increased precipitation being an additional factor.

The problem of local ecological changes has been considered to some extent in

studies of the famous Vero and Melbourne sites. Data on these finds are being reexamined and evaluated by Irving Rouse (MS.) in terms of the newer ecological studies. It is probable that the history of these sites is closely tied to changes in the Indian River.

In the northern Everglades around the south shore of Lake Okeechobee, peat profile studies have disclosed considerable local ecological changes (Dachnowski-Stokes, 1930). Alternate low and high water stages are indicated by the sediments. This is mentioned here because of the evidence of deep archeological sites in these sediments (see the previous section). Unfortunately it is not clear if these variances represent local shoreline or other conditions or whether they are an expression of a broader climatic fluctuation. An examination of the biota of these beds might be fruitful.

Changes in faunal composition.—The West Indies top shell, *Livona pica* Linnaeus, is an abundant shell in many middens along the lower east coast of Florida. It has been seen in almost every archeological site examined between Key Largo and Sugarloaf Key in Monroe County and in numerous sites from Hillsborough Inlet north to Singers Island in Palm Beach County. This distribution coincides with the range of favorable habitat; that is, a rocky shore. These sites were occupied by the Indians in Glades II and III times, circa 1000–1500 A.D. (Fig. 1).

The presence of this shell is of considerable interest because, with the exception of a couple of doubtful records, this mollusk is not now found in Florida (Clench and Abbott, 1943: 9). The present range of the species is the West Indies, and the nearest modern occurrence is their reported presence on Dog Rocks, Cay Sal Bank, not far southeast of the Florida Keys.

What is the significance of their presence? The large quantity of shell found in the sites and the close correlation of their occurrence with their natural rock shore habitat suggests that the shells were locally collected, presumably for food, in the immediate vicinity of the sites. It is of interest to the archeologist whether their extinction in Florida can be attributed to man, to disease, or possibly to some environmental change which caused the animal to contract its range. If the last is the answer, was it purely a local manifestation or was it an expression of a broader change?

Examples of *Anodonta imbecillis* Say (probably specimens of a local species closely related to *A. imbecillis*), a freshwater shell, are described from the Ormond Archaic midden. Blatchley (1902: 72–74) cites Simpson to the effect that the present range of this mollusk is not south of North Carolina.

On the Florida Gulf Coast the *Strombus gigas* Linnaeus, is not now present, although there are records of dead shells or occasional specimens.[8] However, they are reported to occur in shell mounds at Cedar Keys (Calkins, 1878: 228; Ecker, 1878: 101). No shells of this species were seen in shell middens here in the course of a brief visit to this region, but a more intensive study may confirm their presence. Most of these sites were occupied subsequent to 1000 A.D.[9]

Vertebrate remains have not generally been carefully identified in Florida archeology, but one excellent study does point out differences in faunal composition. At South Indian Field, west of Malabar, a wide variety of vertebrate bones were

[8] Worn dead specimens have been noted at Sanibel and Captiva Islands (Perry, 1940: 135). *Strombus costatus* rarely occurs in the vicinity of Tampa Bay (Simpson, 1887–89: 53).

[9] Evidence from other regions in the New World indicates that similar molluscan faunal changes have taken place in recent times. Oysters form a large part of Maine shell heaps, although they are now uncommon in that area. The scallop *Pecten* sp. is also found in these shell heaps although it now lives from Cape Cod to the southward, and the clam *Mercenaria mercenaria* is at present rare north of Cape Cod although it is abundant in Maine shell heaps (Morse, 1925: 430).

In shellheaps on the Pearl Islands, west of the Isthmus of Darién, there were found three species of shells, *Strombus peruvianus*, *Ostrea chilensis*, and *Solen* (*Tagelus*) *dombeyi*, which do not have that northern range at the present time. To complicate things further there was found another species, *Venus* (*Ventricola*) *rugosa*, whose present habitat is the Antilles (Linné, 1929: 128–129).

On the Rio Preto, a tributary of the Rio Grande da Conceicão in Brazil, *Azara* sp. shells were found (in middens) which are of a form not now occurring in the surrounding region (Koenigswald, 1905: 346; also see Serrano, 1946, Ihering, 1903, and Krone, 1914).

identified (Houck, MS.). Among them was an unworked jaw fragment of a beaver, *Castor* sp., found in the early Orange period (Fig. 1). This animal is not now found in the vicinity of the site, although beavers were reported in unspecified localities in northern Florida in Colonial times.[10]

Remains of the great auk have been found in a shell heap near Ormond (Hitchcock, 1902; Blatchley, 1902). Details of the find are lacking, but the identification is apparently well confirmed.[11] This is the same site previously mentioned which was recently excavated by the Florida Park Service.

Changes in faunal size.—Jeffries Wyman (1875: 14) first pointed out that *Ampullaria* and *Paludina* shells (now known as *Pomacea* and *Viviparus* respectively) much larger than those now known, were to be found in shell heaps on the St. Johns River. He gives measurements which illustrate this clearly. Clarence B. Moore substantiated Wyman's findings by discovering even larger examples. However, he went further, pointing out that there has been considerable change in shell size, with the oldest and most modern being similar in size, while those of an intermediate period were larger (Moore, 1892: 921–922; 1893: 115).

It has not been possible to equate precisely Moore's old, middle, and late periods of shell change with the present chronology (Fig. 1), but a rough approximation is possible. There is little question that the first or oldest period with small size shells is the equivalent of the preceramic horizon, for he clearly states this. The period with the largest shells certainly includes in part the Orange and Tick Island horizons (see the Orange Mound, Moore, 1893: 616). However, the other sites listed by Moore as having large shells appear to have been occupied in part into St. Johns II times. Whether these large shells occur in that late horizon is not clear. But it does appear from the data that at least by some time in the St. Johns II horizon, the large size shells disappeared and the mollusks reverted to a size comparable to that now attained.

In association with the large size *Viviparus georgianus* of the middle period was a new form *Viviparus georgianus* var. *altior* Pilsbry (1892: 142). Moore (1892: 922) notes that the proportions of aperture to height of the *Viviparus* changed, but it is not clear whether this new variety represents the change or whether it is within the regular *Viviparus georgianus*.[12]

Data on mammals are limited, but deer bones from South Indian Field appear to represent individuals much larger and more massive than the present range of Florida deer. The remains of the round-tailed muskrat, *Neofiber alleni* True, are also much larger than contemporary forms, so much so that Houck (MS.) has expressed the possibility that they may represent a new variety.

Climatic change as evidenced by vegetation.—The well-known royal palms on the St. Johns River reported by Bartram (1940: 113) are a good example of what may be a recent climatic change in the past 200 years. The modern (circa 1900) natural range of the royal palm is twofold. One area of scattered occurrences is from Little River, Dade County, south and westward beyond Royal Palm Park to the Cape Sable region. In this spread of distribution they are closely associated with tropical vegetation. The other region is the southern end of Fakahatchee Slough or Strand in Collier County. Here the palms flourish in great numbers, reaching 80 to 100 feet in height, but in a temperate cypress and water-oak association. Strangely enough, a thatch palm is also found here. Between these two areas is the small group of palms on Lostmans River.

The most obvious explanation for the presence of the royal palms on the St. Johns would be that they made their northern extension during a warm period and then held on in favorable localities

[10] It may be noted that an extinct form of mink has been described from Maine shell heaps (Prentiss, 1903; Loomis, 1911).

[11] Although the great auk has long been extinct in New England, bones of the bird are very common in Maine shell heaps (Loomis and Young, 1912).

[12] Comparable changes in proportion have been noted in Maine shell heaps and elsewhere in the world in other species of shells (Morse, 1882; 1925).

until cold weather finally killed them off, moving their range southward. It is possible that, once established, they can survive a long time in a nontropical environment (as in Collier County), and that the climatic change that resulted in their extinction in north Florida actually was begun sometime before Bartram's visit in 1773.

CONCLUSIONS

A series of situations has been presented showing changes in the Recent ecology of Florida. These were either observations of early travelers or are data derived from archeological excavation. The changes included differences in sea level, coastal ecology, and in flora and fauna.

At best, much of the value of these data is to awaken interest and to stimulate further work. Because of the nonscientific method of gathering, most of the changes described can not be used for critical work. However, many of these finds could be duplicated under controlled collecting conditions.

The work at South Indian Field can serve as a model for further work, especially when biological and geological specialists are included in the research program. At this site every fragment of animal bone was saved and when possible was identified (Masius, MS.; Houck, MS.). As a result, stratigraphic data, which are tied to the cultural sequence can be given for the animal remains. The detailed survey and testing of Rouse (MS.) clearly bring out the unusual nature of the site in relation to the physical environment.

The future of Recent ecological work in Florida appears to be promising. The very nature of the environment on the border between tropical and temperate zones, plus a long low coastline must have resulted in many changes since the Pleistocene. It is probable that this survey has pointed out only a small amount of the information to be derived in conjunction with archeological work.

To gain the utmost ecological data from archeological work will require real cooperation. The archeologist whose interest is usually only cultural history is loath to collect all animal materials. He has found from experience that few naturalists are equipped to identify or even interested in identifying zoological material, which is often in very fragmentary condition. However, if given any encouragement he will probably be found eager to cooperate in collecting non-cultural material, for the archeological awareness of their value is growing.

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CHEMISTRY.—*Purification of uranium oxide.*[1] JAMES I. HOFFMAN, National Bureau of Standards.

Early in the summer of 1941 Leo Szilard[2] gave a sample of impure uranyl nitrate to the author and requested that the uranium be separated from everything else. It was his desire to obtain the residue, after the removal of uranium, for measurements of neutron absorption. During the same period samples of impure uranium oxide were sent to the National Bureau of Standards for chemical analysis. For both purposes it was desirable to use a solvent that would dissolve the bulk of the uranium without dissolving any of the other substances. The solubility of uranyl nitrate in ethyl ether, first reported by E. Peligot,[3] suggested its

[1] Received April 28, 1948. The information covered in this paper will appear at a later date in Division VIII of the Manhattan Project Technical Series.

[2] Member of Power Production Subsection of the Uranium Committee. See *Atomic Energy*, by Henry D. Smyth, Princeton University Press, 1945.

[3] Ann. Chim. Phys. (3) 5: 5. 1842.

use for extraction of uranium as the nitrate, somewhat as ether is used in steel analysis for the extraction of ferric chloride. This extraction had been successfully applied in 1939 for separating uranyl nitrate from rhenium and certain rare earths in work on the determination of rhenium and molybdenum,[4] but, because of the conflicting statements concerning the solubility of the rare earth nitrates in ether,[5] it was obvious that experimental work was necessary, especially since Szilard stated that certain members of the rare earth group are strong neutron absorbers.

The work herein described is not intended to give the procedure finally used in large-scale production of uranium or the methods used in the various laboratories of the Manhattan Area. Many improvements in procedure have been made since this preliminary work was done.

EXPERIMENTAL

The bulk of the uranium was extracted with ether from 100 g of uranyl nitrate, $UO_2(NO_3)_2.6H_2O$, to which had been added 5 ml of water and "rare earth" nitrates (equivalent to 0.0084 g of oxides) containing cerium, praseodymium, neodymium, erbium, gadolinium, terbium, dysprosium, holmium, erbium, ytterbium, lutecium, scandium, yttrium, lanthanum, and thorium. After removal of most of the uranium, the combined "rare earths" were determined in the residual water solution by precipitating them as fluorides, converting the fluorides to sulphates, then precipitating as oxalates, and igniting the oxalates to "rare earth" oxides. These oxides weighed 0.0086 g. In this particular case the uranium extracted by the ether was not examined for impurities, but it was evident that extraction of uranyl nitrate with ether should be a good starting point for the purification of uranium.

To obtain a quick answer to the possibility of using ether for the purification of uranium a nitric-acid solution of the elements listed in mixture A[6] in nitric-acid solution was evaporated as far as possible on the steam bath. The dry residue was extracted with 100 ml of ether, the ether was washed twice with 5 drops of water, and then the uranium in the ether was converted to oxide.

Qualitative spectrochemical analysis showed that this oxide contained only calcium, magnesium, and silicon, besides uranium. These encouraging results prompted further experiments, which formed the basis for the procedure given in the following section.

PROCEDURE USED FOR THE PURIFICATION OF URANIUM OXIDE

Fifty grams of U_3O_8 was transferred to a 600-ml beaker, 75 ml of diluted nitric acid (1 volume of concentrated nitric acid, sp. gr. 1.42, diluted with 1 volume of water) was added, and the beaker was placed on the steambath until all action ceased. The insoluble matter was removed by filtration, and the residue was washed four or five times with diluted nitric acid (1 volume of nitric acid, sp. gr. 1.42, diluted with 20 volumes of water). The filtrate and washings containing the uranyl nitrate were evaporated to dryness on the steambath. To the *cooled* and *dried* residue in the beaker 5 ml of water and 100 ml of ethyl ether were added, and the beaker was swirled until the uranyl nitrate was dissolved. The large quantities of impurities caused the aqueous phase in the bottom of the beaker to have the appearance of an emulsion, but this did not interfere in separating the layers be-

[4] Ether extraction of uranyl nitrate actually was first suggested to the author by the work of W. F. Hillebrand, U. S. Geol. Surv. Bull. 78: 47. 1891, and such extractions were in use in our laboratory during the 1930's. Although the fact that uranyl nitrate could be extracted with ethyl ether was known for many years prior to the work recorded in this paper (see references in footnotes 3 and 5), data on the neutron-absorbing elements in atomic-energy work were of course not available.

[5] R. C. Wells, Journ. Washington Acad. Sci. 20: 146. 1930; F. Soddy and R. Pirret, Phil. Mag. (6) 20: 345. 1910; W. F. Hillebrand, U. S. Geol. Surv. Bull. 78: 47. 1891; C. W. Davis, Amer. Journ. Sci. (5) 11: 20. 1926.

[6] Mixture A consisted of 2.5 g of uranium metal dissolved in an excess of nitric acid. To this was added as nitrates 2.5 mg each of copper, antimony, lead, aluminum, lithium, zirconium, indium, gallium, bismuth, potassium, dysprosium, cadmium, gadolinium, chromium, magnesium, holmium, cobalt, tin, calcium, and 10 mg of a mixture of "rare earths" known to contain cerium, lanthanum, scandium, praseodymium, thorium, and yttrium.

cause it was possible to pour the ether into a separatory funnel without mixing with the water layer.

The beaker was washed three times with 5-ml portions of ether, which were likewise transferred to the separatory funnel. The funnel was stoppered and shaken vigorously for ½ to 1 minute. After allowing the liquid to stand 3 minutes, a few drops of water appeared in the bottom of the separatory funnel. This water was drained into the beaker that originally contained the ether

TABLE 1.—SPECTROCHEMICAL ANALYSIS[1] OF PRODUCTS OBTAINED IN THE PURIFICATION OF URANIUM OXIDE OR URANIUM FROM ORE CONCENTRATES BY THE PROCEDURE DESCRIBED HEREIN

Element	U_3O_8 #155			U_3O_8 #181			Carnotite ore[2] concentrate		Pitchblende ore[2] concentrate	
	Original oxide	Water extract	Purified oxide	Original oxide	Water extract	Purified oxide	Original ore concentrate	U_3O_8 obtained	Original ore concentrate	U_3O_8 obtained
Ag	T	W	T	VW	W	T	T	T	T	T
Al	VW	W	VW	VW	W	VW	S	—	S	—
As	W	M	—	W	W	—	—	—	—	—
Au	—	T	—	VW	VW	—	T	—	—	—
B	T	VW	—	T	W	—	—	T	T	—
Ba	—	—	—	—	VS	—	M	—	W	—
Be	—	—	—	—	—	—	—	—	VW	—
Bi	VW	W	—	VW	W	—	—	—	W	—
C										
Ca	VS	W	—	W	M	T	VS	T	S	—
Cb	—	—	—							
Cd	—	—	—	—	—	—	—	—	—	—
Ce	—	W	—	—	W	—				
Co	—	—	—	W	M	—	W	—	VW	—
Cr	—	VW	—	—	VS	—	—	—	T	—
Cs	—	—	—	—	—	—				
Cu	VW	M	T	W	M	T	T	T	T	T
Dy	—	S	—	—	S	—				
Er	—	M	—	—	M	—				
Eu	—	M	—	—	M	—				
Fe	W	M	VW	W	M	VW	S	M	S	—
Ga	—	—	—							
Gd	—	M	—	—	M	—				
Ge	—	—	—	—	—	—	—	—	—	—
Hf	—	—	—				—	—	—	—
Hg	—	—	—	—	—	—	—	—	—	—
Ho	—	M	—	—	M	—	—	—	—	—
In	—	—	—	—	VW	—	—	—	—	—
Ir	—	—	—							
K	T	W	—	W	M	—				
La	—	T	—	—	T	—			—	—
Li	—	T	—	—	VW	—				
Lu	—	VW	—	—	VW	—				
Mg	W	W	T	W	W	VW	M	T	M	T
Mn	VW	W	—	W	W	—	W	—	W	—
Mo	W	M	W	W	M	—	—	—	VW	—
Na	W	M	T	M	S	T				
Nd	—	W	—	—	W	—				
Ni	—	VW	—	VW	W	—	—	—	—	—
Os	—	—	—	—	—		—		—	
P										
Pb	VW	W	—	W	M	—	VW	—	M	—
Pd	—	—	—				—		—	
Pr	—	W	—	—	W	—				
Pt	—	—	—	—	W	—	—			
Ra										
Rb	—	—	—	—	—	—				
Re	—	—		—		—	—		—	
Rh										
Ru	—	—	—	—	—		—		—	
Sb	W	M	—	W	M	—	—	—	—	—
Se	—	W	—	—	W	—			—	
Si	M	M	VW	M	W	W	S	VW	W	VW
Sm	—	W	—	—	W	—				
Sn	—	VW	—	—	—	—	—	—	VW	—
Sr	—	—	—	—	VW	—	W	—	VW	—
Ta	—	—	—						—	
Tb	—	M	—	—	M	—				
Te										
Th	—	—	—	—	—	—	—		S	
Ti	—	—	—	—	—		—			
Tl	—	—	—	—	—	—	—	—	W	—
Tm	—	W	—	—	W	—			—	—
U	VS	VS	VS	VS	VS	VS	VS	VS	VS	VS
V	VW	W	—		VS		VS		W	—
W	—	—	—						W	—
Y	—	VS	—	—	VS	—			M	—
Yb	—	M	—	—	M	—				

NOTE.—The designations VS and S correspond to major constituents (greater than 1 percent); M and W to minor constituents (1 to 0.01 percent); and VW, T, and FT to trace constituents (less than 0.01 percent). The absence of a designation indicates that a test was not made for that element.

[1] By V. F. Scribner and H. R. Mullin.

[2] The water extracts contained rare earths, but no attempt was made to identify them individually.

solution. Five ml of water was now added to the solution in the separatory funnel, the mixture was shaken vigorously, and the solution was again allowed to stand until two layers formed. The aqueous phase was drained into the beaker that originally contained the ether solution. The washing with another 5-ml portion of water was repeated once more.

To convert the purified uranyl nitrate to oxide a little water was added to the ether, the ether was cautiously evaporated, and the residue was ignited to U_3O_8 at 1000°C. It was afterward found preferable to add 20 ml of water to the ether solution, shake vigorously for 1 minute, and allow the liquid to separate into two layers. The water layer containing the uranium was drained into a suitable dish, and the extraction with 20-ml portions of water was repeated until the ether above the water was colorless. Three or four such extractions were sufficient to remove the uranium. The combined water extracts were evaporated to dryness, and the uranyl nitrate in the residue was ignited to U_3O_8 at 1000°C. The ether from which the uranyl nitrate had been removed was suitable for future extractions.

The procedure was also applied to the extraction of uranium from pitchblende and carnotite ore concentrates by digesting the ore concentrate with nitric acid, evaporating to dryness, and extracting the residue with ether. The efficacy of this method of purification is shown in Table 1. The table shows that in many cases impurities that were not detected in the original oxide were concentrated and detected in the water extract. Note especially Ce, Co, Cr, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sc, Sm, Tb, Tm, and Y.

DISCUSSION

It was evident that the purification of crude uranium oxide and the removal of uranium from ore concentrates by conversion of the uranium to uranyl nitrate and extraction with ether had possibilities because practically all impurities were removed in a single operation. Tests by L. F. Curtiss[7] indicate that practically none of the radium in the original ore was extracted by the ether.

Under stress of wartime conditions not all the possible confirmatory tests were made, but, as a check on removal of the rare earths, the purified oxides obtained from no. 155 and no. 181, Table 1, were put through a second purification by the same procedure. The water extracts in this case showed no rare earths. Tests by K. D. Fleischer indicated that if 0.5 mg of "rare earth" oxides had remained in the purified oxide, a positive test would have been obtained here. These tests showed also that by this simple procedure the combined "rare earths" in the purified oxide were reduced to less than 5 parts per million. The spectrochemical tests showed that not more than 0.5 part of cadmium or boron per million remained in the purified material.

SUMMARY

A procedure is given for the purification of uranium oxide by converting the oxide to the nitrate and partitioning the nitrate between a large amount of ether and a relatively small amount of water. In modified form, the procedure was found to be applicable to pitchblende and carnotite ore concentrates, as indicated in Table 1.

[7] Chief of Section on Radioactivity at the National Bureau of Standards.

BOTANY.—*Notes on North American Leguminosae.*[1] FREDERICK J. HERMANN, U. S. Department of Agriculture.

In the course of routine identification of collections of Leguminosae sent to the U. S. Department of Agriculture over a period of several years the advisability of proposing the following transfers and changes in status has become apparent. Included also is a diagnosis for an apparently hitherto undescribed *Phaseolus* from Mexico.

[1] Received March 25, 1948.

Acacia schaffneri (S. Wats.), comb. nov.

Pithecolobium schaffneri S. Wats., Proc. Amer. Acad. 17: 352. 1882; *Samanea schaffneri* Macbride, Contr. Gray Herb. 59: 2. 1919; *Poponax*

schaffneri Britton & Rose, N. Amer. Flora **23**: 89. 1928.

Acacia pinetorum, nom. nov.

Vachellia peninsularis Small, Man. Southeastern Flora 654. 1933; not *Acacia peninsularis* (Britton & Rose) Standl., Field Mus. Publ. Bot. **11**: 158. 1936, based on *Senegalia peninsularis* Britton & Rose, N. Amer. Flora **23**: 116. 1928.

Schrankia angustisiliqua (Britton & Rose), comb. nov.

Leptoglottis angustisiliqua Britton & Rose, N. Amer. Flora **23**: 143. 1928.

Schrankia chapmani (Small ex Britton & Rose), comb. nov.

Leptoglottis chapmanii Small ex Britton & Rose, N. Amer. Flora **23**: 141. 1928.

Desmanthus pringlei (Britton & Rose), comb. nov.

Acuan pringlei Britton & Rose, N. Amer. Flora **23**: 134. 1928.

Caesalpinia colimensis, nom. nov.

Brasilettia glabra Britton & Rose, N. Amer. Flora **23**: 321. 1920, not *Caesalpinia glabra* (Mill.) Merrill, Philipp. Journ. Sci. **5**: 54. 1910.

Caesalpinia pumila (Britton & Rose), comb. nov.

Guaymasia pumila Britton & Rose, N. Amer. Flora **23**: 322. 1930; *Caesalpinia gracilis* Benth. ex Hemsl., Diag. Pl. Nov. 9. 1878, not Miq., Fl. Ind. Bat. **1**: 110. 1855.

Dalea tuberculina (Rydb.), comb. nov.

Parosela tuberculina Rydb., N. Amer. Flora **24**: 89. 1920.

Petalostemum candidum Michx., var. **oligophyllum** (Torr.), comb. nov.

Petalostemum gracile var. *oligophyllum* Torr. in Emory, Notes Mil. Rec. 139. 1848; *P. candidus* var. *occidentalis* Gray ex Heller in Britton & Kearney, Trans. N. Y. Acad. Sci. **14**: 33. 1895; *Petalostemon oligophyllus* "Torr.," Smyth, Trans. Kans. Acad. Sci. **15**: 61. 1898; *P. occidentale* (Gray) Fernald, Rhodora **39**: 28. 1937.

Tephrosia virginiana (L.) Pers., var. **leucosericea** (Rydb.), comb. nov.

Cracca leucosericea Rdyb., N. Amer. Flora **24**: 163. 1923; *Tephrosia leucosericea* (Rydb.) Cory, Rhodora **38**: 406. 1936.

Tephrosia ambigua (M. A. Curtis) Chapm., var. **intermedia** (Small), comb. nov.

Cracca intermedia Small, Bull. Torr. Bot. Club **21**: 303. 1894.

Astragalus tenellus Pursh, var. **strigulosus** (Rydb.), comb. nov.

Homalobus strigulosus Rydb., Bull. Torr. Bot Club **34**: 420. 1907; *Astragalus tenellus f. strigulosus* Macbr., Contr. Gray Herb. **65**: 34. 1922.

Astralagus michauxii (Kuntze). comb. nov.

Tragacantha michauxii Kuntze, Rev. Gen. 941. 1891; *A. glaber* Michx. 1803, not Lam. 1783.

Astragalus ceramicus Sheld., var. **filifolius** (Gray), comb. nov.

Astragalus pictus var. *filifolius* A. Gray, Proc. Amer. Acad. **6**: 215. 1864; *Psoralea longifolia* Pursh, Fl. Amer. Sept. 741. 1841, not *Astragalus longifolius* Lam. 1783; *Astragalus mitophyllus* Kearney, Leafl. W. Bot. **4** (8): 216. 1945.

The above combination is necessitated by the fact that Gray's *Astragalus pictus* (Proc. Amer. Acad. 6: 214. 1864) is a later homonym of the validly published *A. pictus* Boiss. & Guillardot in Boiss., Diagn. Pl. Orient. Ser. 2, **3** (6): 55. 1859, so that *A. ceramicus* Sheld. must be taken up in its stead for our American plant. Although Dr. Kearney's epithet is available for Gray's var. *filifolius* when treated in specific rank, the proportion of specimens intermediate between it and *A. ceramicus* that have come to the attention of the writer leads to the conclusion that varietal status may be more appropriate for it.

Centrosema arenicola (Small), comb. nov.

Bradburya arenicola Small, Fl. Southeastern U. S. 651. 1903.

Desmodium arenicola (Vail), comb. nov.

Meibomia arenicola Vail, Bull. Torr. Bot. Club **23**: 140. 1896; *Hedysarum lineatum* Michx., Fl. Bor. Amer. **2**: 72. 1803, not L. 1759; *Desmodium lineatum* (Michx.) DC., Prodr. **2**: 330. 1825.

Although the name *Desmodium lineatum* (Michx.) DC. has been in general use for this plant it can be maintained only in spite of Article 61. An unfortunate consequence of this rule, as it now stands, is that a later homonym is rendered permanently *hors de combat*, even though the specific epithet upon transference to another genus would not constitute a homonym in its new context.

Rhynchosia simplicifolia (Walt.) Wood, var. **intermedia** (T. & G.), comb. nov.

Rhynchosia tomentosa β intermedia T. & G., N. Amer. Fl. 1: 285. 1838; *R. intermedia* (T. & G.) Small, Man. Southeastern Flora 715. 1933.

Phaseolus neglectus, sp. nov.

Herba volubilis; stipulis lineari-oblongis, 3–5 nerviis, 5–6 mm longis, rigidis; stipellis lineari-oblongis, 2–3 mm longis; foliolis deltoideo-acuminatis vulgo plus minusve lobatis; pedunculis 5–11 cm longis: bracteis persistentibus, rigidis, 6–9 mm longis, 5-nerviis, subtus plerumque pilosis: pedicellis tenuibus glabratis; bracteolis caducis, uninerviis; calyce campanulato-cupuliformi; corolla 20 mm longa; vexillo obovato, valde emarginato; alis orbiculari-ovatis; ovario dense piloso.

Herbaceous vine; stems slender, sparsely puberulous with reflexed hairs to glabrate; stipules linear-oblong, 3–5 nerved, 5–6 mm long, rigid; petioles puberulous to glabrate, 3–6 cm long; stipels linear-oblong, rigid, 2–3 mm long; leaflets 3, membranaceous, deltoid-acuminate, sparsely puberulent above, glabrous to sparsely puberulent beneath, 2–6 cm long, 2–4.5 cm wide, lobed (often only shallowly so or even entire), the median 3-lobed, the lateral 2-lobed, the lobes round-ovate and generally shallow; peduncles slender, 5–11 cm long, 11–25-flowered; bracts persistent, green, lanceolate-acuminate, firm, 5-nerved, generally more or less pilose beneath, sparingly so to glabrate above, 6–9 mm long, 1–1.5 mm wide at base; pedicels slender, glabrate, 3.5–5 mm long; bracteoles caducous, green, narrowly linear-lanceolate, one-nerved, glabrous, 2–2.5 mm long; calyx campanulate-cupuliform, 2.5–3.5 (lower lip up to 5) mm long, very sparingly ciliolate, the lower lip irregularly pilose, prominently 3–lobed with median lobe 2.5 mm long, acute, upper lip very shallowly 2–lobed; corolla 20 mm long, pale salmon to light blue; standard obovate, 16 mm long, 12 mm wide, deeply emarginate, the upper half reflexed; wings orbicular-ovate, abruptly contracted into a broad claw, its lower half adnate to the keel; keel tubular, with two complete coils; free stamen with a reniform enlargement above the base; style-beard extending around the first coil; stigma lateral; ovary linear, densely pilose.

Nuevo León, Mexico in oak woods along trail up Sierra de la Cebolla from La Trinidad, Municipio de Montemorelos, *C. H. Muller* 2881, Aug. 20, 1939 (TYPE—U. S. National Arboretum Herbarium).

Nearest allied to *Phaseolus foliaceus* Piper, of the Sierra Madre. From this it differs in its longer, linear-oblong, rather than triangular-lanceolate stipules; its 5-nerved, linear-lanceolate bracts which are pilose below; its shallowly lobed leaflets; longer peduncles bearing racemes with more numerous flowers; campanulate-cupuliform calyx which is almost imperceptibly ciliolate; corolla 20, rather than 10, mm long; obovate, deeply emarginate standard; and orbicular-ovate wings.

MYCOLOGY.—*Two new species of* Physarum.[1]

G. W. MARTIN, State University of Iowa.

The two species of *Physarum* here noted were included in the extensive collections of Myxomycetes made by William Bridge Cooke on Mount Shasta, Calif., and submitted by him for identification. One of them proves to be identical with two old collections from Mount Rainier, Wash., which have been in this laboratory for many years awaiting determination. Both appear to be clearly distinct from any recognized species in this large genus.

[1] Received November 5, 1947.

Physarum rubronodum, sp. nov.

Sporangiate, globose to obovate or pulvinate, sessile or borne on weak, strandlike stalks produced as extensions of the hypothallus, pinkish brown, or dark when lime is scanty in peridium, 1–1.5 mm in diameter, densely clustered on a common hypothallus; peridium double, the outer layer cartilaginous, calcareous, shining, crustose, smooth except for a coarse overlying reticulation or, when lime is scanty, dark and lacking the reticulation, the inner layer membranous, closely applied, colorless,

iridescent; hypothallus prominent, silvery to yellow, venose, the veins often projecting as stalk-like extensions on which sporangia are borne; capillitium profuse, close-meshed, bearing large fusiform or irregularly angular scarlet or pinkish nodes, most of the junctions limeless; spores nearly black in mass, dark violaceous brown by transmitted light, slightly paler on one side, densely and somewhat ir-

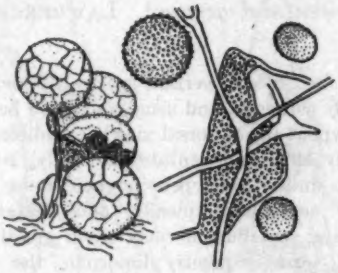


FIG. 1.—*Physarum rubronodum*. Left, group of sporangia (*Cooke* 15671a) on hypothallus, ×12; right, detail of capillitium with two spores (*Cooke* 18126), ×520; above, spore of same, ×1,000.

regularly verruçose, globose, 11–13μ in diameter, or oval and correspondingly longer and narrower. Plasmodium scarlet or orange-red.

Sporangiis globosis vel obovatis vel pulvinatis, sessilis vel substipitatibus, miniato-brunneis, 1–1.5 mm diam., dense caespitosis sub hypothallo commune; peridio duplici, extus cartilagineo, calcareo, crustaceo, nitente, laeve praeter crasso reticulato; intus membranaceo, applicato, hyalino, iridescente; capillitio denso e filamentis hyalinis reticulato-anastomosatis, nodulis calcareis, magnis, fusiformibus vel irregulariter angularibus, coccineis vel miniatis multis axillis ecalcareix; sporis globosis vel subovoideis, atropurpureo-brunneis crebro grosseque tuberculatis 11–13μ diam. Plasmodio coccineo vel aurantiaco.[2]

CALIFORNIA: Mount Shasta, 8,000 feet, elev., July 7, 1941, *W. B. Cooke* 15671a, TYPE. Same locality, June 29, 1947, *W. B. Cooke* 18126.

Physarum rubronodum is obviously close to *P. albescens* Macbr. Like that species, it has a crustose outer wall suggesting *Leocarpus*, and many of the sporangia are borne on strandlike extensions of the hypothallus. It differs in the pinkish-brown or dark peridium, in the striking scarlet nodes, in the somewhat smaller, warted rather than spiny spores, and in the scarlet or deep orange-red plasmodium.

Physarum auripigmentum, sp. nov.

Sporangiate, stalked, gregarious; sporangium globose, 0.4–0.6 mm in diameter, total height 0.6–1 mm., clear to opaque yellow (about lemon-chrome of Ridgway); peridium membranous, closely covered by subcircular limy scales; dehiscence somewhat petaloid; columella none; stalk short, about half the diameter of the sporangium, cylindrical, expanded at the base, orange-red, limeless, translucent; hypothallus scarcely evident; capillitium dense, delicate, persistent, the nodes small, rounded, bright yellow, many of the junctions limeless and with numerous free, pointed ends; spores dark brown in mass, clear violet-brown by transmitted light, nearly smooth, (8.5–) 9.5–11 (–12.5)μ in diameter, Plasmodium unknown.

Sporangiis stipitatibus, gregariis, globosis, 0.4–0.6 mm diam., totis 0.6–1 mm altis, lucidis haud pellucidis luteis; peridiis membranaceis, squamis suborbiculatis calcareis applicatis; subfloriforme dehiscentibus; columella nulla; stipes brevis, attingens dimidium diametrosis sporangii, cylindraceus, expansus basi, aurantiacus, ecalcareus, translucidus; hypothallo quo

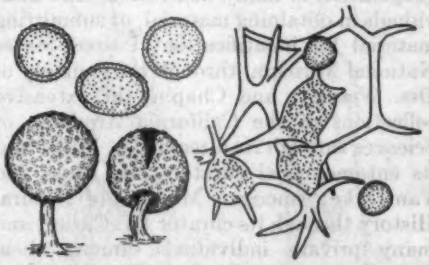


FIG. 2.—*Physarum auripigmentum* (*Cooke* 20099). Left below, two sporangia, ×60; right, detail of capillitium, with two spores, ×520; left, above, three spores, ×1,000.

vix sentiri; capillitio denso, delicato, persistente, nodulis parvulis rotundatis, luteis, multis axillis ecalcareis, apicibusque multiplicibus, apertis, acutis; sporis atro-brunneis, violaceo-brunneis pellucente, sublevibus, 9.5–11μ diam. Plasmodio ignoto.

CALIFORNIA: Mount Shasta, 8,000 feet elev., June 23, 1947, *W. B. Cooke* 20099, TYPE.

[2] I am indebted to Sister Mary Cecelia Bodman for assistance with the Latin diagnoses.

WASHINGTON: Longmire Springs, Mount Rainier, August 10–17, 1928, *D. B. Creager* S. U. I. 1722; Paradise Valley, Mount Rainier, August, 10–17, 1928, *D. B. Creager* S. U. I. 1723.

Physarum auripigmentum suggests *P. oblatum* Macbr. but differs in the scaly character of the peridium, in the shorter and brighter stalks without dark basal deposits, and especially in the dense capillitium, with its small, regular nodes, numerous lime-free junctions and conspicuous free ends.

ENTOMOLOGY.—*Synoptic revision of the United States scarab beetles of the subfamily Dynastinae, No. 5: Keys to tribes and genera.*[1] LAWRENCE W. SAYLOR, California Academy of Sciences.

This paper completes my studies covering a synoptic review of the United States dynastine scarab beetles, the preceding four parts having been published in this same JOURNAL.

A great deal of work, from a taxonomic standpoint, remains to be done in the American members of this tribe, especially in the Neotropical genera. Generic limits of such genera as *Ligyrus* and *Stenocrates*, as well as many others, must be thoroughly studied and the relative importance of such characters as the front male claws (enlarged or not), the dentition of the mandibles, and the usual sexual dimorphism must be better understood.

In the present studies I have had the cooperation of many institutions and individuals in obtaining material, or submitting material for identification: United States National Museum, through the courtesy of Drs. Wetmore and Chapin; the extensive collections of the California Academy of Sciences through its director Dr. Miller and its entomological curators Drs. Ross and Van Dyke; American Museum of Natural History through its curator Dr. Cazier; and many private individuals, among them Drs. Cartwright, Ritcher, Reinhard, and Sanderson, as well as Dr. Dampf of Mexico City. I have also received material from the Paris Museum through Dr. Paulian, and from the British Museum through Dr. Hinton and Mr. Arrow, to all of whom I am indebted for numerous past favors.

SUBFAMILY DYNASTINAE

Diagnostic characters.—Tarsal claws always *equal* in size, or at least so on the middle legs (one claw of the front pair is frequently enlarged in males of certain species); mandibles entirely corneous, and usually exposed beyond the clypeus (from dorsal view); mandibles frequently large and dentate externally; labrum hidden under the clypeus; clypeus more commonly acuminate apically, and dentate or edentate; scutellum normal, never greatly enlarged; sexes frequently dimorphic, the males frequently with tubercles or horns on either head or thorax or both, the females in many species likewise equipped; coloration usually some shade of black or brown, only very rarely with any metallic lustre; antennal club always relatively small and 3-segmented; ligula entirely connate with the mentum; abdominal spiracles diverging strongly behind; anterior coxae transverse, not prominent; stridulating organs frequently appear in many species, located on propygidium or inside the elytra; fifth ventral sternite and propygidium connate, the last spiracle on the suture between them; onychium between the tarsal claws commonly bisetose, varying to multisetose in certain genera.

KEY TO UNITED STATES TRIBES

1. Labial palpi inserted *behind* the mentum; body always *depressed* above; frequently with tubercles or horns on head or thorax; mid-disc of thorax often longitudinally impressed; hind tibia digitate or truncate at apex but not noticeably widened; first segment of hind tarsus with strong spine at apex; sexual differences hardly apparent... ..... PHILEURINI

   Labial palpi inserted *at the sides* of the ligular part of the mentum; body never strongly depressed, usually evenly convex dorsally; head and thorax horned or not; sexual characters noticeable in last abdominal sternite or front tarsal claw in all instances..... 2

2. Head and thorax in both sexes entirely *unarmed, without* tubercles or carinae or horns, and never depressed or foveate; claw with the onychium always bisetose (never more

[1] Received September 3, 1947.

than two cilia); stridulating organs absent; male front claws in many species either enlarged or larger than in female; antenna often larger in male than female; tarsi cylindrical and usually elongate, never triangular; prosternal spine prominent behind the fore coxae . . . . . CYCLOCEPHALINI

Head and thorax (either or both) armed with

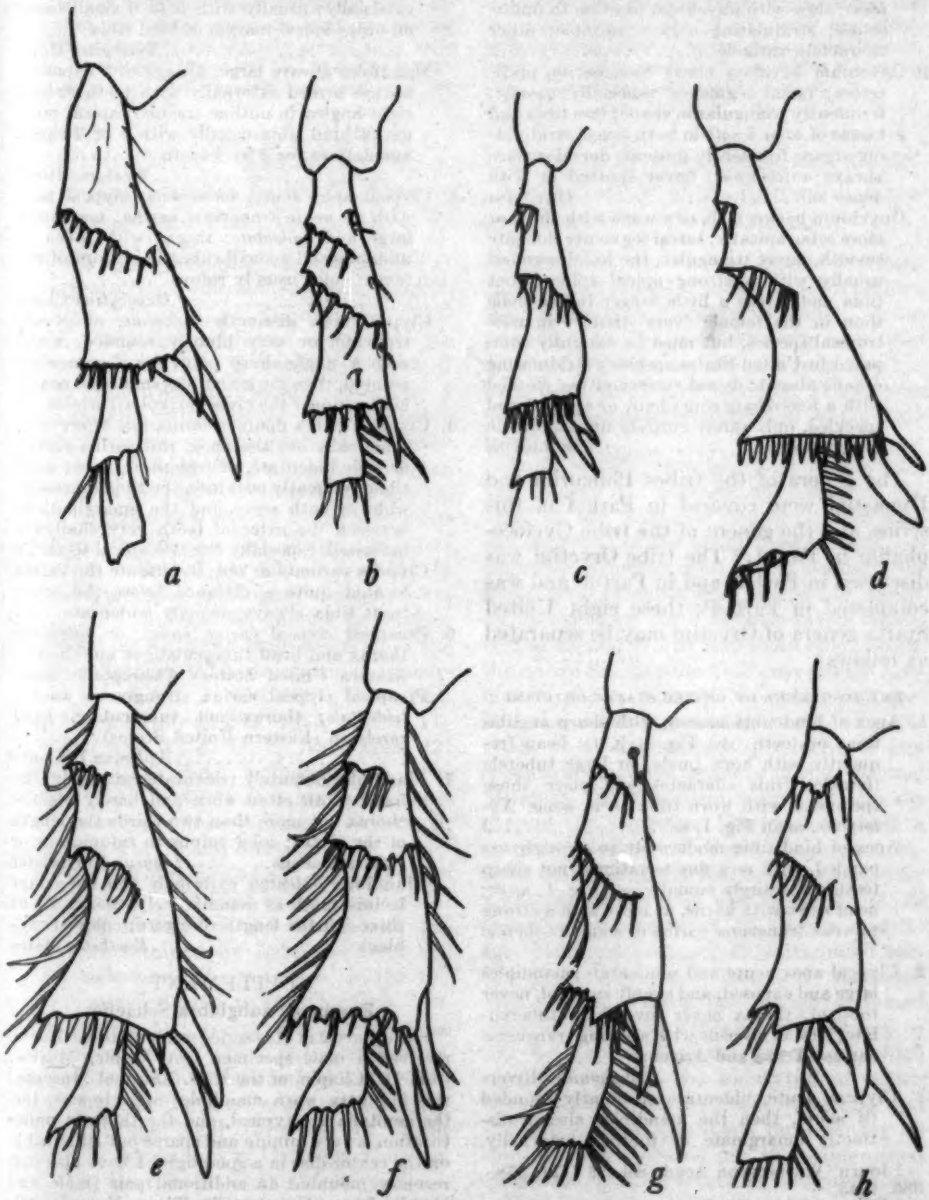


FIG. 1.—*a*, *Ligyrus relictus* Say: Hind tibia of male; *b*, *Euetheola subglabra* Schaeffer: Hind tibia of male; *c*, *Aphonus densicauda* Casey: Hind tibia of male; *d*, *Cheiroplatys clunalis* LeConte: Hind tibia of male; *e*, *Xyloryctes jamaicensis* (Drury): Worn hind tibia of male; *f*, same as *e*, fresh tibia; *g*, *Strategus antaeus* (Drury): Hind tibia of male; *h*, *Strategus mormon* Burmeister: Hind tibia of male.

horns or tubercles (on fore margin of thorax if nowhere else) in both sexes, and frequently foveate (*or* with strong head carina and large, well-rounded mandibles as in *Aphonides*); claw with onychium bisetose to multisetose; stridulating organs variable; other characters variable.....3

3. Onychium between claws bisetose to plurisetose; tarsal segments, especially basally, frequently triangular in shape; fore tibia and tarsus of *same length* in both sexes; stridulating organs frequently present; dorsal surface always *unicolorous;* never spotted or with dense hair.....ORYCTINI

Onychium between claws always with three or more setae apically; tarsal segments elongate smooth, never triangular, the basal segment usually with a strong apical spine; front tibia and tarsus a little longer in the male than in the female (very distinct in neotropical species, but must be carefully compared in United States species); stridulating organs absent; dorsal surface either clothed with a fine *velvety* short hair, or spotted and speckled, only rarely entirely unicolorous in some females.....DYNASTINI

The genera of the tribes Phileurini and Dynastini were covered in Part 4 of this series, and the genera of the tribe Cyclocephalini in Part 1.[2] The tribe Oryctini was discussed in Part 2[3] and in Part 3[4] and was completed in Part 4[5]; these eight United States genera of Oryctini may be separated as follows:

KEY TO GENERA OF UNITED STATES ORYCTINI

1. Apex of hind tibia *uneven*, with sharp angulations or teeth (see Fig. 1, *g, f*); head frequently with horn (male) or large tubercle (female) (this character will place those specimens with worn tibia as in some *Xyloryctes*, as in Fig. 1, *e*.....2

Apex of hind tibia moderately to strongly expanded, with *very fine* serrations (not sharp teeth) or entirely smooth (see Fig. 1, *a, d*); head *never* with horns, at most with a strong to weak transverse carina or a small tubercle 4

2. Clypeal apex acute and unidentate; mandibles large and exposed, and evenly *rounded*, never toothed; thorax never foveate or tuberculate; base of clypeus with a strong transverse carina (Texas and Arizona).....*Aphonides* Rivers

Clypeus acute, bidentate or bluntly rounded (if acute, then the mandibles always distinctly emarginate or toothed externally, and thorax always foveate and tuberculate) 3

3. Mandibles usually hidden beneath the clypeus, or only edges exposed, and always unarmed externally; usually with 5 to 9 small teeth on outer apical margin of hind tibia..... .....*Xyloryctes* Hope

Mandibles always large, always well exposed, always armed externally with teeth or else right-angled in outline (*cessus*); apical margin of hind tibia usually with 1 or 2 sharp angulations, or 3 or 4 teeth..... .....*Strategus* Hope

4. Clypeal apex acute, *unidentate;* clypeal base with an acute transverse carina; mandibles large and *tridentate;* thorax with fovea at midapex and a small tubercle in front of the fovea; color usually rufous..... .....*Ozygrylius* Casey

Clypeal apex distinctly *bidentate*, or evenly truncate, or very bluntly rounded, never with a single sharp point (*or* if somewhat pointed, then the mandibles small and nearly hidden under the clypeus); color variable..5

5. Clypeus with a distinct carina *just before* (i.e., practically *on*) the apex, this carina entire, or wide bidentate, or tridentate; front male tibia frequently edentate, the tibia unusually wide in both sexes and the emarginations between the external teeth very shallowly indicated, especially the two apical teeth..6

Clypeus carinate or not; if carinate the carina located quite a distance *before* the apex; front tibia always strongly tridentate....7

6. Preapical clypeal carina *entire*, or *bidentate;* thorax and head tuberculate or not (Southwestern United States). *Cheiroplatys* Hope

Preapical clypeal carina strongly to weakly *tridentate;* thorax not tuberculate, head rarely so (Eastern United States)..... .....*Aphonus* LeConte

7. Mandibles definitely tridentate externally, the basal tooth often worn and barely visible; thorax not more than two-thirds the length of the elytra; color rufous to rufopiceous or rufocastaneous.....*Ligyrus* Burmeister

Mandibles *bidentate* externally (do not count lacinia tooth as mandibular!); thorax about three-fourths length of elytra; color always black.....*Euetheola* Bates

SUPPLEMENT

Euetheola subglabra Schaeffer

Since Part 2 of this series was published I have received a male specimen from Tepic, Mexico, from Dr. Chapin, of the U. S. National Museum; this has very worn mandibles and clypeus, but the genitalia are typical, and the thoracic puncturation is very minute and sparse but still visible on the center disc in a good light. I have also just recently mounted an additional pair (male and female) from "Compostella, Tepic, Nayarit, collected VI-24-40 at light by Morgan M. and L. W. Saylor"; these were mixed in with some un-

[2] Journ. Washington Acad. Sci. 35 (12): 378–386. 1945.
[3] Ibid. 36 (1): 16–22. 1946.
[4] Ibid. 36 (2): 41–46. 1946.
[5] Ibid. 38 (5): 176–183. 1948.

mounted *Dyscinetus* material, which they greatly resemble superficially. The female has not been described before and I am designating this specimen as the *Allotype:* Very similar to male except that it is a little larger (16 mm), the minute thoracic punctures are entirely absent over most of the center-disc, the apical half of the pygidium is smooth and very sparsely punctate and the apical half of the sixth sternite is entirely smooth and impunctate. It is interesting that nearly the entire abdomen (except for a single transverse setigerous row on each sternite near sides) and the metasternum (except at sides) are highly polished and entirely impunctate in both sexes. Both specimens remain in the Saylor Collection at the California Academy of Sciences.

ENTOMOLOGY.—*The Herbert H. Smith collection of South American Chalcidoidea described by W. H. Ashmead.*[1]

A. B. GAHAN, U. S. Bureau of Entomology and Plant Quarantine. (Communicated by E. A. CHAPIN.)

In his *Classification of the chalcid flies or the superfamily Chalcidoidea* (Mem. Carnegie Mus. 1 (No. 4, pt. 2): 394–551. 1904) W. H. Ashmead published results of his study of the Herbert H. Smith collection of South American chalcidoids, including a bibliographic catalogue of all the known South American species. Many new species were described, most of them based upon material in the Smith collection, but several of the included new species were based upon material in the United States National Museum, collected by Albert Koebele. In the bibliographic catalogue, citations were given for a number of species previously described by Ashmead from material in the Smith collection, these descriptions appearing in Insect Life 3: 456. 1891; Proc. Ent. Soc. Washington 3: 233. 1895, and 4: 11–14. 1896; and Proc. U. S. Nat. Mus. 22: 368–375. 1900. Also included were Ashmead's identifications of a number of species described by Walker, Westwood, Fabricius, Perty, and other authors.

Holotypes of 8 species and duplicate paratypes of 36 additional species, as well as duplicates of some of the determined species, were retained by Ashmead from the Smith collection. The remainder of the collection was returned to the Carnegie Museum, which had acquired it by purchase from the collector. There the collection remained practically undisturbed until 1934, when through the kind cooperation of the late Dr. Hugo Kahl, then curator of the section of entomology at Carnegie Museum, and with the consent of the Museum director, I was permitted to bring the whole collection to the United States National Museum for study. Though it still remained the property of Carnegie Museum, it has reposed in the National Museum since that date and while being used for reference has been kept, until very recently, in the original boxes and arrangement in which Ashmead left it.

Early in 1947, through collaboration with Dr. George E. Wallace, successor to Dr. Kahl at the Carnegie Museum, and with the approval of the authorities of both the Carnegie Museum and the National Museum, arrangements were completed whereby, in exchange for a representative collection of named North American chalcidoids, the entire Smith collection covered by Ashmead's paper, with the exceptions of one-half the duplicates in any series of paratypes or of determined specimens of any species, became the property of the National Museum. With consummation of the exchange the Carnegie Museum received a named collection of North American material comprising 412 species represented by 1,222 specimens and also a return of 22 paratypes representing 16 species and 84 specimens representing 19 determined species from the South American material. The National Collection acquires named representatives of 248 species made up of 192 holotypes, 79 paratypes (8 of which represent species the holotypes of which were already in the National Museum), and 156 determined specimens representing 48 species. Also included are 122 unidentified specimens, making a total of 549 specimens.

Unfortunately, the unique types of *Parencyrtus brasiliensis* Ashmead, *Pelorotelus coeruleus* Ashmead, *Horismenus corumbae*

[1] Received March 7, 1948.

Ashmead, *Euplectrus brasiliensis* Ashmead, and *Stenomesius dimidiatus* Ashmead have become dislodged from the mounting points and lost. Since the first two species are genotypes, their loss is doubly unfortunate. Also missing from the collection is the specimen (or specimens) of *Idoleupelmus annulicornis* Ashmead recorded from Santarém, Brazil. This species was originally described (Proc. Ent. Soc. Washington 4: 13. 1896) from the Island of St. Vincent, West Indies, and the holotype is presumably in the British Museum.

The material from the Smith collection acquired by the National Museum has now been removed from the original boxes and placed in standard trays and drawers. While making the transfer I made the following notes regarding certain species:

Hemitorymus thoracicus Ashmead.—In my opinion this is not a monodontomerine. The type appears to be a typical *Torymus* and the genus *Hemitorymus*, therefore, a synonym. New synonymy.

Plesiostigmodes brasiliensis Ashmead.—The unique type is a male, not a female as stated in the description.

Spilochalcis tarsalis Ashmead.—The type is from Corumba instead of Chapada.

Spilochalcis persimilis Ashmead.—Type locality Santarém instead of Chapada.

Spilochalcis bimaculata Ashmead.—Described only in the key to species. The type, a female, is from Trinidad.

Spilochalcis nigropleuralis Ashmead.—The holotype female is from Trinidad. The only male associated with this female in the collection is from Corumba (not Chapada), Brazil, and does not entirely fit the description given of the male. It does not bear a name label and may or may not be the allotype.

Spilochalcis mayri Ashmead.—The type is from Corumba, not Chapada.

Spilochalcis urichi Ashmead.—No male is described, but included among the 12 specimens in the type series is one male. This is colored almost exactly like the females and not easily distinguished.

Spilochalcis lineocoxalis Ashmead.—The unique holotype is a male, not a female.

Spilochalcis chapadensis Ashmead.—In the key to species (p. 427) and on the name label, the name of this species is *chapadensis*, but heading the formal description (p. 443) it is given as *chapadae*. That the latter spelling is a lapsus is obvious, since the name *chapadae* had already been used for another species of *Spilochalcis* (p. 432). The name *chapadensis* should be retained for the species on p. 443.

Spilochalcis persimilis Ashmead.—The unique holotype is a male instead of a female.

Octosmicra nigromaculata Ashmead.—The locality is Corumba instead of Chapada.

Heptasmicra lineaticoxa Ashmead.—One paratype is from Maruru, the type and 2 paratypes from Santarém.

Metadontia similis Ashmead.—The unique holotype is a female instead of a male.

Pentasmicra brasiliensis Ashmead.—Described only in the key to genera. See article by Hugo Kahl (Ann. Carnegie Mus. 13: 265. 1921).

Axima brevicornis Ashmead.—The male allotype and 4 male paratypes of this species do not appear to be the same species as the female holotype and the female paratype. Instead, these males all seem to me to be *A. koebelei* Ashmead.

Aximopsis morio Ashmead.—The type locality for this genotype species, not recorded by Ashmead, is Santerém, Brazil.

Isomodes brasiliensis Ashmead.—Only 4 of the 5 specimens recorded by Ashmead were found, the specimen from Santarém being missing.

Prodecatoma bruneiventris Ashmead.—The type series consists of 3 females and 1 male. In my opinion the 3 females represent 3 different species. The male allotype is labeled "*Prodecatoma flavescens* Ashmead. ♂ Type," but since no male was described for *flavescens* and since this male specimen agrees with the description of the male as given for *bruneiventris*, it is obvious that the labeling is a lapsus.

Neorilya flavipes Ashmead.—The type series, of which only 9 specimens can be located, is a composite made up of apparently 3 different species.

Rileya orbitalis Ashmead.—The unique holotype female is from Chapada instead of Santarém. A male in the National Museum collection from Chapada is labeled "*Rileya orbitalis* ♂, Type No. 8080." Ashmead may have originally associated this with the female holotype, but since no male is mentioned in the

description it should not be considered a paratype. This male is apparently not the same species as the holotype but appears to be identical with *Rileya insularis* Ashmead.

Lelaps affinis Ashmead.—A paratype, U.S.N.M. no. 8087, is not the same species as the holotype but belongs instead to *Lelaps ferruginea* Ashmead.

Chalcedectes annulipes Ashmead.—Holotype from Corumba in May. Paratype from Chapada already in National Museum collection.

Macreupelmus brasiliensis Ashmead.—Only 3 of the 4 specimens mentioned by Ashmead located. U.S.N.M. type, no. 8091.

Anastatus auriceps Ashmead.—Holotype from Corumba. Paratype from Chapada missing from pin.

Trichencyrtus chapadae Ashmead (pp. 291, 392) (= *robustus* Ashmead, p. 495). See comments by Gahan and Peck, Journ. Washington Acad. Sci. 36: 317. 1946; also Gomes, Bol. Soc. Brazil. Agronomia 5: 287. 1942.

Metopon brasiliensis Ashmead.—The holotype female is from Corumba. The 2 paratype females are from Santarém and appear to be not the same species as the type. The allotype male, also from Santarém, is missing from the pin.

Horismenus brasiliensis Ashmead.—A specimen in the National Museum from Chapada labeled "Type No. 8094" is not the same species as the holotype, which is from Rio de Janeiro. This specimen from Chapada is not mentioned in the description and hence is neither type nor paratype.

Ametallon chapadae Ashmead.—The holotype from the Smith collection is in poor condition. The paratype which was in the National Museum and recorded in the type book under no. 8097 is missing from the pin.

Trichoporus melleus Ashmead.—The holotype acquired with the Smith collection is a female from Santarém. The alleged male described by Ashmead and bearing U.S.N.M. type, no. 8098 is a female from Chapada and is not the same species as the holotype.

Trichoporus viridicyaneus Ashmead.—All 20 specimens of the type series located, 3 of them in the National Museum under type no. 8099. These 3 are the same species as the holotype, but at least 5 of the paratypes in the Smith collection appear to be a different species.

Alophus flavus Ashmead (p. 353, 365) (= *brasiliensis* Ashmead, p. 520). See comments by Gahan and Peck, Journ. Washington Acad. Sci. 36: 314. 1946. Holotype and allotype from Chapada and one paratype from Rio de Janeiro in Smith collection. Holotype and paratype are alike, but the allotype male is a different species. Also two alleged paratypes in the National Museum, type no. 8100, are not the same as the holotype and represent two different species.

ORNITHOLOGY.—*Continental races of the bulbul* Pycnonotus dispar (*Horsfield*).[1]

H. G. DEIGNAN, U. S. National Museum.

Geographical variation in continental populations of *Pycnonotus dispar* ("*Otocompsa flaviventris*" of the older authors) appears in a tendency to darker coloration of the upperparts, shortening of the crest, and reduced wing length from north and west to east and south. The effects of wear on the plumage are so marked that only fresh-plumaged specimens are suitable for taxonomic study, and the change from one form to another is so gradual that the distinctions between juxtaposed races can be observed only in series. The difficulty of establishing satisfactory limits of range for the several subspecies is complicated by the appearance of winter-wandering examples of one within the breeding territory of another. Two hundred and one specimens from the Asiatic mainland, brought together in Washington with the kind cooperation of the authorities of the Academy of Natural Sciences of Philadelphia (A.N.S.P.) and of the Chicago Natural History Museum (C.N.H.M.), enable me to accept the following forms:

1. Pycnonotus dispar flaviventris (Tickell)

Vanga Flaviventris Tickell, Journ. Asiat. Soc. Bengal 2: 573. Nov. 1833 (Dampara, "in Dholbhûm"=Singhbhum District, Chota Nagpur Division, Province of Bihar and Orissa, India).

[1] Published by permission of the Secretary of the Smithsonian Institution. Received January 16, 1948.

Diagnosis.—Head and neck blue-black; upperparts *golden* olive-green, somewhat brighter posteriorly; exposed portions of remiges and rectrices blackish brown, edged with golden olive-green; underparts rich yellow, somewhat suffused with olive on the breast and along the flanks.

Wing length.—86–91 mm. (5 males), 85–89 mm. (4 females), 85–96 mm. (4 unsexed).

Specimens examined.—"INDIA": No definite locality (3 unsexed). BENGAL: Darjiling District: Sivok (1 male, 2 females). ASSAM: No definite locality (1 unsexed); Cachar District: Rupachena (1 female); Lakhimpur District: Margherita (1 male, 1 female). BURMA: Myitkyina District: N'Pon Village (1 male); Pakokku District: Dudaw Taung (2 males).

2. Pycnonotus dispar vantynei, n. subsp.

Type.—C.N.H.M. no. 79247, adult male, collected at Phongtho (lat. 22°32′ N., long. 103°20′ E.), Laokay *or* Laichau Province, northwestern Tongking, on February 24, 1929, by J. Van Tyne (original number 396).

Diagnosis.—As large as *P. d. flaviventris*, but easily separable by having the upperparts a darker and duller olive-green, almost without golden suffusion.

Wing length.—85–91 mm (20 males), 85–87 mm (4 females).

Specimens examined.—ANNAM: No definite locality (1 male); Thanhhoa Province: Hoixuan (1 female), Lunglunh (1 male). TONGKING: Laokay *or* Laichau Province: Phongtho (2 males); Laokay Province: Ba Nam Nhung (1 male); Laichau Province: Muong Mo (1 male, 2 females), Muong Moun (1 male), Paham (1 male), Laichau (1 male), 27 km W8W. of Laichau (2 males). LAOS: 5e Territoire Militaire: Bountai (3 males), Muong Yo (1 male, 1 female); Pakse Province: Pakse (1 male, *winter*). BURMA: Kengtung State: Loi Mwe (3 males, 1 female), Mong Len (1 male); SIAM: North: Chiang Saen Kao (2 females), Chiang Rai (1 male), Muang Fang (1 male), Wiang Pa Pao (1 female), Doi Suthep (2 males, *winter*); East: Ban Chanuman (1 male, *winter*).

Remarks.—Only one of these examples shows the red-throated phase of plumage (discussed below under *P. d. johnsoni*).

This race is named in honor of Josselyn Van Tyne, collector of the type specimen.

3. Pycnonotus dispar xanthops, n. subsp.

Type.—U.S.N.M. no. 332362, adult male, collected at "Khan River" = Ban Mae (lat. 18°40′ N., long. 98°50′ E.), Chiang Mai Province, northwestern Siam, on February 8, 1932, by Hugh M. Smith (original number 5321).

Diagnosis.—Smaller than either of the two precedent races and with the color of the upperparts darker, more greenish, less golden, than in *flaviventris*, but much lighter and more golden than in *vantynei*.

Wing length.—83–87 mm. (16 males), 83–85 mm. (4 females).

Specimens examined.—SIAM: Northwest: Doi Chiang Dao (1 male), Muang Pai (1 male), 30 km N. of Chiang Mai (1 male), Doi Suthep (5 males, 3 females), vicinity of Chiang Mai (3 males, 1 female), Ban Mae (2 males), Doi Khun Tan (6 males). BURMA: Amherst District Myawadi (1 male), Kawkareik (1 female).

Remarks.—This race presumably has a much more extensive range than my material shows; it should be the form of all southern Burma.

The few skins available from southwestern Siam are smaller than *xanthops;* their plumage is so badly worn that, for the present, they must be left unnamed.

4. Pycnonotus dispar auratus, n. subsp.

Type.—A.N.S.P. no. 115110, adult male, collected at Amphoe Wat Pa = Muang Lom Sak, on the borders of central and eastern Siam at lat. 16°45′ N., long 101°10′ E., on October 26, 1934, by collectors for R. Meyer de Schauensee (original number 1705).

Diagnosis.—Smaller than either *vantynei* or *flaviventris* and with the color of the upperparts lighter, less greenish, more golden, than in the former, but much darker and less golden than in the latter.

From *P. d. xanthops*, with which it agrees in size, *auratus* is separable by having the upper parts slightly darker and less golden.

Wing length.—85–87 mm (4 males), 82–84 mm (5 females).

Specimens examined.—LAOS: Vientiane Province: Vientiane (1 female). SIAM: Central *or* East: Muang Lom Sak (4 males, 5 females). ANNAM: Phanrang Province: Krongpha (1 female, *winter*).

Remarks.—*P. d. auratus* and *P. d. xanthops* are equivalent "links" in the cline between *flaviventris* and *vantynei*. The range of *auratus*

may be expected to cover the more eastern provinces of northern Siam, the northern half of the eastern Siamese plateau, and portions of Haut- and Moyen-Laos between the territories of *vantynei* and *johnsoni*.

One of my specimens shows the red-throated phase of plumage; another has an irregular spot of red and yellow feathers at the left side of the chin.

5. **Pycnonotus dispar johnsoni** (Gyldenstolpe)

Rubigula johnsoni Gyldenstolpe, Kungl. Svenska Vet.-Akad. Handl. **50** (8): p. 25, col. pl. 1. July 19, 1913 (near Sathani Chakkrarat, Nakhon Ratchasima Province, eastern Siam at lat. 15°00′ N., long. 102°25′ E.).

Diagnosis.—Near to *P. d. auratus*, but smaller and with the upperparts slightly darker and less suffused with golden.

Wing length.—79–85 mm (33 males), 76–83 mm (34 females), 81–83 mm (3 unsexed).

Specimens examined.—SIAM: East: Sathani Pak Chong (7 males, 9 females), Sathani Hin Lap (3 males), Sathani Lat Bua Khao (5 males, 3 females), Ban Tha Chang (1 unsexed), Ban Khanong Phra (2 females), Ban Pang Sok (1 male), Nakhon Nayok (1 unsexed), Ban Chanuman (4 females), Ban Khulu (1 unsexed), Ban Khemmarat (1 female); Southeast: Khao Saming (2 males, 1 female), Ban Bang Phra (1 male, 1 female), Ban Laem Ngop (1 male), Khao Sa Bap (3 males, 1 female), Khao Soi Dao (1 male), Muang Rayong (2 females), Siracha (1 male), Ban Nong Kho (3 males), Ban Nong Yang (4 males); LAOS: Pakse Province: Pakse (2 males, 4 females), Paksong (1 female, 1 unsexed), Bassac (1 female). CAMBODIA: Kampot Province: Ok Yam (1 female); Siemreap Province: Banteai Srei (1 female); Kompong Cham Province: Kompong Cham (1 female). ANNAM: Phanrang Province: Krongpha (1 female, 1 unsexed), between Bellevue and Daban (1 male, 3 females), Fimnon (1 female), Ban Methuot (1 male).

Remarks.—A color phase in which the lower throat is clothed in shining red feathers is frequent in *johnsoni;* in the population of the southwestern corner of the eastern Siamese plateau (topotypical), all the specimens seen show the character, which appears with diminishing frequency as one moves away from this center and is then often indicated merely by a few red feathers among the black. Since red-throated individuals appear in any predominantly black-throated population of southeastern Indo-China (and even in populations otherwise representative of the races *auratus* and *vantynei*), it is not possible to restrict the use of Gyldenstolpe's name to red-throated birds without seeming to have two subspecies resident at the same localities, and there is, of course, no question here of two sympatric species. A case precisely similar to this is presented by the bulbul *Pycnonotus atriceps* (Temminck), in which the several color phases appear with varying frequencies from one to another part of the ranges of the different races.

The problem has been discussed at some length by R. Meyer de Schauensee (Proc. Acad. Nat. Sci. Philadelphia **98**: 53–56. 1946), whose conclusions, however, do not wholly agree with mine.

6. **Pycnonotus dispar caecilii,** n. subsp.

Type.—U.S.N.M. no. 160418, adult male, collected in Trang Province, peninsular Siam at *ca.* lat. 7°–8° N., on February 12, 1897, by William L. Abbott.

Diagnosis.—Nearest *P. d. johnsoni* (black-throated phase), but with the upperparts a decidedly darker olive green, almost without golden suffusion.

Wing length.—78–82 mm (10 peninsular males), 78–81 mm (6 peninsular females).

Specimens examined.—SIAM: Southeast: Ko Kut (3 males, 1 female, 1 unsexed), Ko Chang (8 males, 1 female, 1 unsexed); Southwest: Prachuap Khiri Khan (1 female), Khao Luang (1 male, 2 females), Khao Nok Wua (1 male, 1 female); Peninsula: Ban Tha Lo (1 female), Nakhon Si Thammarat (1 male), Khao Phanom Bencha (3 males, 1 female), Trang Province (4 males, 2 females). BURMA: Mergui District: Victoria Point (1 male). MALAYA: Selangor State: Ginting Bidei (1 male).

Remarks.—This race was named *Otocompsa flaviventris minor* by Boden Kloss (Ibis, ser. 10, **6** (2): 200. Apr. 9, 1918), with the type specimen from Ko Lak = Prachuap Khiri Khan. With the submersion of *"Otocompsa"* in *Pycnonotus*, Kloss's name becomes preoccupied by *Pycononotus nigricans* Var. *minor* von Heuglin (Ornithologie Nordost-Afrika's **1**: 398. 1869), and a new designation is required for the bird of the Malay Peninsula.

Kloss's type lies before me and seems to be inseparable from more southern specimens.

Nevertheless, since Prachuap Khiri Khan is situated just where numerous peninsular races intergrade with distinct forms of southwestern Siam, it has seemed to me desirable to fix the new name on a much more southern population, rather than simply to rename Kloss's bird. The word *"caecilii"* derives, of course, from this earlier worker's given name.

That the 15 specimens from Ko Kut and Ko Chang should be quite distinct from birds of the neighboring mainland, but virtually inseparable from those of the Malay Peninsula, is of considerable interest. Their wing length ranges from 81 to 85 mm (11 males), 80 to 83 mm (2 females); they are thus a trifle larger than topotypical *caecilii*, but hardly enough to justify their separation at this time. One example has a few red feathers on the lower throat.

ICHTHYOLOGY.—Acanthurus triostegus marquesensis, *a new subspecies of surgeonfish, family Acanthuridae, with notes on related forms.*[1] LEONARD P. SCHULTZ and LOREN P. WOODS.

During our studies of tropical Pacific Ocean fishes, we observed that in the vast area from the East African coast to the western shores of the Americas certain species said by certain ichthyologists to be the same throughout this entire region are actually separate species, subspecies, or distinct populations. Among these, the surgeonfish, *Acanthurus triostegus* (Linnaeus), is one of the most abundant and widely distributed species of the Indo-Pacific region. It ranges from the Red Sea and Natal coast of South Africa eastward to Australia and thence in Oceania to the offshore American islands—Clarion, Clipperton, and Cocos. In the Hawaiian chain of islands this surgeonfish is represented by a distinct species, *Acanthurus sandvicensis* Streets, and by some means it has extended its range to include Johnston Island, 520 miles southward.

In order to clarify the status of the various species and subspecies of surgeonfishes closely related to *A. triostegus* we studied specimens from the Pacific and Indian Oceans and found that certain of the larger island groups of the Pacific have populations of this surgeonfish morphologically distinct from other island groups. Therefore, we find it necessary to describe as new a subspecies from the Marquesas and to point out other distinct populations without naming them at this time.

Throughout the entire range of this surgeonfish the five narrow dark bars on the sides show no significant variability. The first body band ends in the axil of the pectoral base. In contrast the dark bar on caudal peduncle varies greatly from a dorsally located spot to one completely encircling the peduncle. Usually it is in the form of a dorsal saddle with a spot ventrally disconnected from the saddlelike dark mark.

The larval stages of this surgeonfish are unknown to us, but numerous examples of postlarvae occur in the U. S. National Museum collections. All have been taken over reefs or near land; those from 21 to 25 mm in length have been collected from tidal pools. The smallest specimen seen by us was 20.5 mm. It was colorless when it appeared at a light at night. This suggests a pelagic habitat for the young.

Acanthurus sandvicensis Streets

Acanthurus triostegus sandvicensis Streets, U. S. Nat. Mus. Bull. 7: 67. 1877. (Type locality, Honolulu Harbor, Oahu, T. H.) Lectotype, U.S.N.M. no. 15398, and paratypes, U.S.N.M. no. 143446.

Acanthurus sandvicensis Streets is characterized by having a black streak running from the upperpart of the pectoral base to near the ventral surface (see Fig. 1, A), and by averaging one or two more soft rays in the dorsal, anal, and pectoral fins. (See Table 1.) The streak below the pectoral was found in all specimens examined (about 100) from the Hawaiian and Johnston Islands and in no specimen from any other locality.

The distinct character of the color pattern of *Acanthurus sandvicensis* and its complete lack of intergradation with representatives of *trio-*

[1] Published with the permission of the Secretary of the Smithsonian Institution. Received March 23, 1948.

stegus from other island groups reemphasize the recognized long-time isolation of the Hawaiian Chain. The average temperature of the water around the Hawaiian Islands and Johnston Island is a little lower than the average for most parts of the equatorial western Pacific Ocean. This may have caused the meristic differences recorded for *sandvicensis*, but it does not explain the difference in color pattern.

Acanthurus triostegus triostegus (Linnaeus)

Chaetodon triostegus Linnaeus, Systema naturae, ed. 10: 274. 1758. (Type locality, Indies.)

The normal color pattern of alcoholic specimens is a light-gray to dark-brown background on head and body with the dorsal parts darker, and ventral region whitish; middorsal line of interorbital space and of snout usually with a brown streak; head and body with 5 narrow transverse brownish or blackish bars, the first from nape through eye across cheek to lower margin of preopercle, the second from dorsal origin to base of pectoral, the third from below fifth dorsal spine nearly to anus, the fourth from base of second dorsal soft ray to first soft anal ray, and the fifth from about the seventh to ninth dorsal rays to below the eighth soft anal ray; caudal peduncle usually with a narrow black saddle across dorsal surface extending down to about middle of sides, lower part of caudal peduncle usually with a small spot or short dash (sometimes the dorsal saddle is connected with this spot but this character has been found to be too variable to consider here); median fins dusky, the anal with a narrow white margin; pectoral fin translucent.

The normal or typical color mark on the upper part of pectoral fin base (Fig. 1, B) consists of a single dark spot.

Specimens in breeding colors have a distinct lengthwise line along lower sides, below this, body abruptly white, anal fin black basally, often with a broad white margin; the transverse lines on females apparently narrower than those of males.

Variability among island groups.—The specific marks that show consistent variability along certain lines center around the pectoral fin base, such as (1) a dark spot below pectoral fin base, or (2) the elongation of the usual round dark spot into a short bar. These changes usually occur along with an increase of about one additional ray in the dorsal, anal, or pectoral fins.

Among the specimens from the Indian Ocean and western Pacific—Marianas, Marshall, and Samoan Island groups—only an occasional specimen differed from the normal color pattern of *triostegus*. Four out of five specimens from Tahiti had one more pectoral fin ray on both sides, but no color variations. One specimen each available from the isolated Baker, Christmas, and Fanning Islands were normal *triostegus*.

In one-third of the Phoenix Island specimens there occurred either an extra spot, a bar (Fig. 1, D), or an elongate spot (Fig. 1, E), and about one-third had one more pectoral fin ray than the average for *triostegus*. This may indicate a variation in the direction of *sandvicensis*.

Of the six small specimens examined from the Tuamotus, four had a bar across the pectoral base (Fig. 1, D) and two had one spot, and one specimen had an additional pectoral fin ray.

FIG. 1.—Diagram showing different color patterns on base of pectoral fin: A, *Acanthurus sandvicensis;* B, normal *A. triostegus;* C, *A. triostegus marquesensis* (adult); D, bar; E, elongate spot (Phoenix Islands); F, elongate spot (in juvenile *marquesensis*).

No notable difference in color pattern was observed for examples from the American offshore islands of Clarion, Clipperton, and Cocos, but half of them have an extra ray in the pectoral fin. Jordan and Evermann (Bull. U. S. Bur. Fish. 23 (1): 395. 1905) state: "To the Hawaiian species, *Hepatus sandvicensis*, belong the specimens recorded by Jordan and Evermann (U. S. Nat. Mus. Bull. 47, pt. 2: 1690. 1898), from Clarion and Socorro Islands." Our 11 specimens from Clarion have a single spot on the pectoral base with no indication of the extension or streak below the pectoral characteristic of *sandvicensis*. Heller and Snodgrass (Proc. Washington Acad. Sci. 6: 403. 1900) list 37 specimens from Cocos Island and say: "All of the Revillagigedo and Cocos specimens differ from Hawaiian specimens of the very closely related *Hepatus sandvicensis*

(Streets) in lacking the black band reaching from the base of the pectoral to the base of the ventral. There is a dark spot on the outer side of the base of the pectoral and in some a similar spot below this one." This is in harmony with our findings.

Acanthurus triostegus is one of the few tropical Indo-Pacific species that crosses the East Pacific Barrier (Ekman, 1935, pp. 105–107). One would suppose this Eastern Pacific-American area to be more isolated than any of the Central Pacific island groups, yet we can detect no significant variation.

Acanthurus triostegus marquesensis, n. subsp.

Hepatus triostegus Fowler, Proc. U. S. Nat. Mus. 80: 10. 1932.

Holotype.—U.S.N.M. no. 89771, Marquesas Islands, Ua Huka, September 24, 1929, Gifford Pinchot, 84.3 mm.

Paratypes.—U.S.N.M. no. 143447, same data as holotypes, 13 specimens, 49 to 86 mm; C.N.H.M. nos. 23065, 23066, Marquesas Islands, Nuka Hiva Island, February 7, 1929, Crane Pacific Expedition, 2 specimens, 31 and 38 mm; C.N.H.M., nos. 23062, 23063, 23064, Marquesas Islands, Hiva Oa Island, February 6, 1929, Crane Pacific Expedition, 3 specimens, 25.7 to 28.5 mm.

Description.—(The counts and measurements of the holotype are given first, the range of variation of paratypes in parentheses, measurements expressed in thousandths of the standard length.) Dorsal rays IX, 24 (IX, 22 to 24); anal rays III, 21 (III, 19 to 21); pectoral rays I, i, 14 (13 or 14); pelvic rays I, 5 (I, 5); branched caudal rays upper lobe 7, lower lobe 7; teeth on one side of jaws, upper 7 (7), lower 8 (7 or 8).

Depth of body 529 (510 to 605); length of head (tip of snout to upper edge of gill opening) 312 (315 to 331); length of snout 193 (176 to 198); diameter of eye 93 (93 to 136); least depth of caudal peduncle 109 (110 to 127); length of pectoral fin 173 (268 to 321); postorbital part of head (hind margin of eye to upper edge of gill opening) 54 (51 to 78); lower lobe of caudal fin 284 (268 to 315), upper lobe 285 (277 to 333); interorbital width 91 (94 to 125); length of caudal spine 32 (29 to 47; angle of snout profile 57 (54 to 56); snout profile slightly concave convex in young; caudal fin slightly forked.

Color.—In alcohol, head and body dark brown, with five transverse narrow dark lines, the first from nape through eye to lower margin of preopercle, the second from origin of spiny dorsal to axil of pectoral fin, the remaining three as described for *triostegus;* dark line form-

TABLE 1.—COUNTS AND COLOR CHARACTERISTICS RECORDED FOR ACANTHURUS TRIOSTEGUS AND A. SANDVICENSIS

Species and Locality	Dorsal rays								Anal rays						Pectoral rays			Coloration of pectoral base			
	VIII	IX	X	21	22	23	24	25	III	18	19	20	21	22	I, i, 12	I, i, 13	I, i, 14	One spot	Bar	Two spots	Streaks
Acanthurus triostegus triostegus:																					
Indian Ocean, Mauritius; Seychelles	—	11	1	—	6	5	1	—	12	1	1	7	3	—	—	12	—	10		2	
Sumatra; New Guinea; Solomons; Philippines	—	10	—	1	3	6	—	—	10	—	3	6	1	—	2	8	—	10			
Okinawa; Japan	—	7	—	—	2	4	1	—	7	—	3	3	1	—	—	7	—	5	1	1	
Guam; Marshalls	—	21	—	—	7	13	—	1	21	—	2	17	1	1	—	17	4	21			
Niuafu; Samoa	—	8	—	—	3	4	1	—	8	—	—	5	3	—	—	6	2	7		1	
Phoenix Islands	—	11	—	—	1	8	2	—	11	—	—	7	4	—		10	6	30	10	3	
Tahiti	1	3	—	—	1	2	1	—	4	—	1	2	1	—		2	6	4			
Tuamotus; Mangareva; Takaroa	—	6	—		1	5	—	—	6	—	—	4	2	—	1	11	2	2	4		
Eastern Pacific, Clarion, Clipperton; Cocos Islands	—	14	—	3	2	9	1	—	14	—	2	6	5	—		7	7	14			
Acanthurus triostegus marquesensis:																					
Marquesas	—	14	—		2	10	2	—	14	—	1	6	7	—		10	24		4	15	
Acanthurus sandvicensis:																					
Hawaiian and Johnston Islands	—	32	—		1	13	16	2	32	—	1	5	24	2	—	5	27				32

ing saddle over dorsal surface of caudal peduncle extending down sides of caudal peduncle and joining with spot on lower side on one side, lower spot separate on other side (these are joined on at least one side in 5 paratypes, separate on both sides in 17); holotype and paratypes 49 to 86 mm, with a large distinct spot below the pectoral fin base (Fig. 1, C); young specimens 25.7 mm have a faint dark bar about twice as long as diameter of pectoral base, narrowing and fading ventrally but not as long as in *A. sandvicensis;* in the 31-mm specimen the pectoral spot is conspicuous and in the form of an elongate bar, pinched in the middle and tapering ventrally; on one 38-mm example the bar has completely divided into a short bar across the base of pectoral in one side and lower half is more or less rounded into a spot as those of 49 to 86 mm, but on the other side the division into two parts is not quite complete (Fig. 1, F). A distinct spot on pectoral fin base; a small faint spot near lower edge of gill opening, and 3 faint spots in line along side of breast, median fins dark, the anal with a narrow white border; pelvics dark, their outer margin and tips pale.

Remarks.—On all the Marquesas Islands specimens occurs a large dark spot below the pectoral fin base except in very small specimens as described above in addition to the usual spot on the pectoral base. Only occasional specimens of *A. triostegus triostegus* from other parts of the Pacific and Indian Oceans have this additional spot. In the Marquesas Islands this extra spot occurs along with a consistently higher average number of anal and pectoral fin rays, thus separating the new subspecies from *A. triostegus triostegus.* Named *marquesensis* after the island group where this subspecies occurs.

ZOOLOGY.—*The tardigrade fauna of the District of Columbia.*[1] CHARLES B. CURTIN,[2] Catholic University of America. (Communicated by E. G. REINHARD.)

The Tardigrada constitute a group of microscopic animals usually included, as a class, in the phylum Arthropoda. All are hygrophilous, but some species are restricted to marine and fresh-water habitats. Their distribution is world-wide, the number of species being greater in the sub-Arctic than in the tropical regions. No reference to a study of the Tardigrada of the District of Columbia was found in the literature, but Marcus (1929, p. 576) and Mathews (1938, pp. 624–626) listed one species, *Macrobiotus hufelandii* C. Schultze, as an inhabitant of this area. The results of a survey conducted by the writer in this region are contained in this paper.

Packard (1873, p. 740) was the first to note the presence of a tardigrade in the United States, but his description is unfortunately inadequate. A tardigrade from New Gloucester, Maine, was described by Beal (1880, p. 593). The species, however, can not be determined with accuracy. Mathews (1938, p. 625) stated that it fits the description of *Hypsibius augusti* Murray. To date, 14 species of Tardigrada have been reported for the United States. Of this number, two, *Batillipes mirus* Richters and *Bathyechiniscus tetronyx* Steiner, are marine species. The two described by Packard and Beal are incertae sedis. None of the species reported for the United States are peculiar to this country as they have been previously noted as inhabitants of other countries.

Terrestrial Tardigrada inhabit lichens and mosses while aquatic species may be found on water plants. Richters (1927, pp. 1–3) noted that the tropical mosses were poor both in species and number. In his survey, Murray (1907, p. 515, and 1913, p. 136) listed 25 species of Tardigrada from South Africa. The exact localities of the collections were not given, but from the regional topography the average elevation was 4,000 feet. Teunissen (1938, pp. 6–15) listed 1,200 meters as the lowest elevation

[1] A contribution from the Department of Biology, the Catholic University of America, Washington, D. C. This paper, prepared under the direction of Dr. E. G. Reinhard, is based on the author's dissertation submitted in partial fulfillment of the requirements for the degree master of science. Received January 16, 1948.

[2] Now biology instructor at Mount St. Mary's College, Emmitsburg, Md.

TABLE 1.—LIST OF TARDIGRADA REPORTED FROM THE UNITED STATES (compiled from papers of Marcus, Mathews, and Packard)

Species	Locality	Authority
1. *Batillipes mirus* Richters (*B. caudatus* Hay)	Beaufort, N. C.	W. P. Hay
2. *Bathyechiniscus tetronyx* G. Steiner	California coast	Mathews
3. *Echiniscus arctomys* Ehrenberg	Brandon, Vt.; East Troy, Wis.	Mathews
4. *Echiniscus merokensis* Richters	San Juan Island and Longmires Springs, Wash.	Mathews
5. *Pseudechiniscus suillus* Ehrenberg	Brandon, Vt.; Catalina Island, Calif.	Mathews
6. *Macrobiotus hufelandii* C. Schultze	Ephraim and East Troy, Wis.; Washington, D. C.; Isle Royal, Mich.; San Juan Island, Wash.	Mathews Marcus Mathews
7. *Hypsibius schaudinni* Richters	Galveston, Tex.	Mathews
8. *Hypsibius prosostomus* Thulin	Isle Royal, Mich.	Mathews
9. *Hypsibius canadensis* Murray	Catalina Island, Calif.	Mathews
10. *Hypsibius convergens* Urbanpwicz	Niagara Falls, N. Y.	Marcus
11. *Hypsibius oberhäuseri* Doyère	East Troy, Wis.; Catalina Island, Calif.	Mathews
12. *Milnesium tardigradum* (Schrank)	East Troy Wis.; Techny, Ill.; Friday Harbor and San Juan Island, Wash.	Neuhaus Mathews
SPECIES INCERTAE SEDIS		
13. *Hypsibius augusti* Murray	New Gloucester, Maine	Beal
14. *Hypsibius americanus* Packard	New Gloucester, Maine	Packard

at which he found Tardigrada. These elevations approximated those of the subalpine region, and environmental conditions would favor the support of a tardigrade fauna. Despite the unfavorable physiography of the District of Columbia, foliose lichens and water samples collected from the Rock Creek Park, Fort Dupont Park, and the Catholic University campus yielded 39 specimens. Two were aquatic and 37 were terrestrial forms. These represented three definite species and two of uncertain nature. Table 2 lists the species and location where the Tardigrada were obtained.

Macrobiotus hufelandii C. Schultze

1834. *Macrobiotus hufelandii* Schultze, Macrobiotus Hufelandii, animal e crustaceorum classe novum reviviscendi post diuturnam asphyxiam et ariditatem potens . . . Berolini.
1895. *Macrobiotus eminens* Ehrenberg, Abh. Adad. Wiss. Berlin, 1858: 452, pl. 2, fig. 1, A–E.
1914. *Macrobiotus interruptus* Della Valle, Ann. Mus. Zool. Napoli, Suppl. 1, no. 7: 29.

Twenty-one specimens of this species were obtained. The average length of the larger specimens was 500μ. The eyespots were black and prominent. The cuticle of the live animals appeared annulated with wide bands of gray-white color separated by a thin, clear constricted area. Typical claws present with basal lunulae. Lamellae surrounded the mouth. The pharynx was ovoid with distinct commas. The anterior macroplacoid touched the apophyses.

Milnesium tardigradum (Schrank)
Fig. 2

1803. *Arctiscon tardigradum ?* Schrank, Fauna Boica 3 (1): 195.
1840. *Milnesium tardigradum* Doyère, Ann. Sci. Nat., Zool. ser. 2, **14**: 283.
1859. *Acrophanes schlagintweitii* Ehrenberg, Abh. Akad. Wiss. Berlin, 1858: 451, pl. 1, fig. 1, A–F.

Fifteen specimens were obtained which were well pigmented and of the characteristic orange-brown color. The largest was 416μ long. The eye spots were large and black. The cephalic palps were prominent and the wide, short buccal

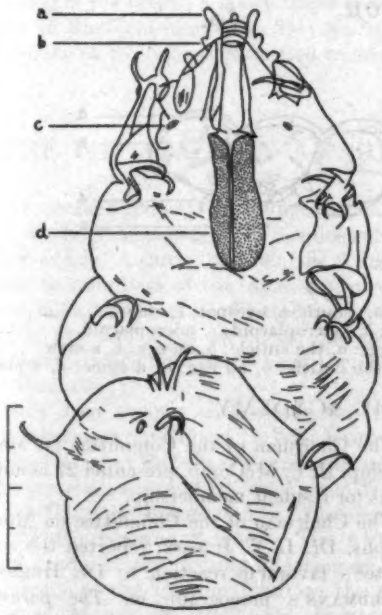
TABLE 2.—TARDIGRADA FOUND IN THE DISTRICT OF COLUMBIA

Species	Locality
1. *Macrobiotus hufelandii* C. Schultze	Rock Creek Park
2. *Milnesium tardigradum* (Schrank)	Rock Creek Park
3. *Hypsibius dujardini* (Doyère)	Catholic University Campus
4. *Hypsibius* sp.	Catholic University Campus
5. *Hypsibius* sp.	Fort Dupont Park

tube emptied into a saclike pharynx lacking placoids. The claws were united at the base by a cuticular band.

1

1a



2

FIG. 1.—*Macrobiotus hufelandii*, lateral view: *a*, eyespot; *b*, cuticular depression or pearl; *c*, peribuccal lamellae; *d*, macroplacoids. FIG. 1a.—Pharynx of *M. hufelandii*: *a*, buccal tube; *b*, stylet; *c*, tooth bearer; *d*, apophysis; *e*, macroplacoid; *f*, microplacoid or comma; *g*, pharyngeal bulb.

FIG. 2.—*Milnesium tardigradum*, ventral view: *a*, external palp; *b*, lateral palp; *c*, eye spot; *d*, pharynx.

Hypsibius dujardini (Doyère)

Fig. 3, 3a

1840. *Macrobiotus dujardin* Doyère, Ann. Sci. Nat., Zool., ser. 2, 14: 288.
1851. *Macrobiotus lacustris* Dujardin, Ann. Sci. Nat., Zool., ser. 3, 15: 164.
1911. *Hypsibius dujardini* Thulin, Arkiv Zool. 7 (16): 33.

Of this small, transparent, aquatic form, only a single specimen was obtained. It measured 177μ. The eyespots were black and the claws dissimilar, the basal part being short. In the short straight buccal tube, the anterior macroplacoid was longer than the posterior. The cuticle appeared to be a faint gray-green color in the abdominal region.

Hypsibius species

Fig. 4

The identification is based upon a molt which contained four ovoid eggs. These measured 22μ by 39μ. The length of the animal was 162μ. The claws were partially concealed but appeared to be the *Hypsibius* type. The cuticle showed some spiny protuberances leading to the belief it might be *Hypsibius ornatus* Richters.

Hypsibius species

Fig. 5

This identification is assigned to a skin with 13 eggs obtained in a water sample. The eggs were slightly ovoid measuring 48μ by 61μ. The molt measured 168μ. The claws appeared to be of the *Hypsibius* type and it approximated the description of *Hypsibius dujardini* (Doyère). It appeared very probable that it was the molt of this species.

Thirty-nine specimens of Tardigrada were obtained in the survey, and duplicates have been deposited in the United States National Museum. Three distinct species and two of a dubious nature were represented. Mosses were found to be poor habitations for Tardigrada, while foliose lichens in the Rock Creek Park area yielded the best results. Of the 10 good terrestrial and aquatic species reported for the United States, two, *Macrobiotus hufelandii* C. Schultze and *Milnesium tardigradum* (Schrank) are inhabitants of the District of Columbia. The range of *Milnesium tardigradum* (Schrank) can now be extended to include this region. The presence of *Hypsibius dujardini* (Doyère) is the first reported occurrence of this species for the United States. The possibility of one

molt being *Hypsibius ornatus* Richters would add another species to the list of those that inhabit the United States. All specimens were found to be smaller than the average of those reported from colder regions.

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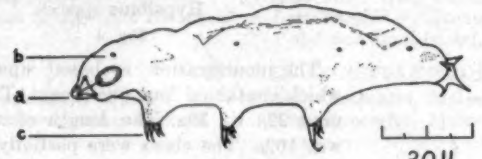

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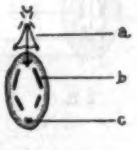

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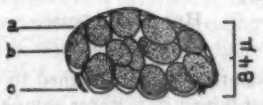

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FIG. 3.—*Hypsibius dujardini*, lateral view: *a*, mouth; *b*, eyespot; *c*, claws.
FIG. 3a.—Pharynx of *H. dujardini*: *a*, stylet; *b*, macroplacoid; *c*, microplacoid.
FIG. 4.—*Hypsibius* species. Molt containing 13 eggs: *a*, the cuticle; *b*, an egg; *c*, a claw.
FIG. 5.—*Hypsibius* species. Molt containing 4 eggs: *a*, the cuticle; *b*, an egg; *c*, a spine; *d*, a claw.

PROCEEDINGS OF THE ACADEMY

418TH MEETING OF BOARD OF MANAGERS

The 418th meeting of the Board of Managers held in the Cosmos Club, May 17, 1948, was called to order at 8:05 P.M. by the President, Dr. F. D. ROSSINI. Others present were: H. S. RAPPLEYE, N. R. SMITH, J. I. HOFFMAN, F. G. BRICKWEDDE, W. N. FENTON, W. RAMBERG, T. D. STEWART, J. W. ALDRICH, C. E. WHITE, W. W. RUBEY, W. A. DAYTON, C. A. BETTS, M. A. MASON, A. O. FOSTER, C. L. GAZIN, and, by invitation, H. E. MCCOMB, F. C. KRACEK, L. V. JUDSON, and F. THONE.

The Chairman of the Committee on Membership, H. E. McComb, presented 27 nominations for resident membership.

The Chairman of the Committee on Monographs, Dr. L. V. JUDSON, reported the committee's favorable reaction to Dr. HERBERT FRIEDMANN's monograph on *The parasitic birds of Africa.* Upon a motion by Dr. Judson, the Board voted to accept the bid of the Lord Baltimore Press to publish, in buckram binding, 1,000 copies of the monograph at a cost to the Academy of approximately $2,100. It was agreed that the map of North Africa recom-

mended to Dr. Friedmann should be included, raising the printing cost about $30. Dr. Judson recommended that the price the Academy is to charge for copies of the monograph be fixed so that the cost of publication is returned in the sale of half of the edition.

Dr. FRANK THONE, the Academy representative on the Joint Committee on Press Relations, presented a report on the financial standing of the committee which the Board voted to refer to the Executive Committee for consideration and recomendation.

The Chairman of the committee appointed to consider and make recommendations regarding an index to the JOURNAL, Dr. W. N. FENTON, presented a report which was also referred to the Executive Committee for consideration and recommendation.

The Secretary reported the result of the ballot submitted to the membership regarding the change in the Bylaws proposed at the 417th meeting of the Board: 1. Amendment to create office of President-elect (Yes, 254; No. 10). 2. Amendment to increase permitted number of active members (Yes, 251; No. 13). Total ballots cast, 264.

The Secretary announced the death of ALBERT FRED WOODS, an original member, on April 12, 1948.

The Board approved the following changes in the Standing Rules proposed at the 417th meeting:

Section 3, third sentence, replace by—

"The Committee on Membership, Meetings, Grants-in-Aid for Research, and each of the Subcommittees of the Committee on Awards for Scientific Achievement shall include, if possible, at least two members reappointed from the preceding year. The Committee on Monographs shall have six members, each appointed for three years at the rate of two each year. At least three members of the Committee on Monographs shall be past editors of the JOURNAL, if possible."

New Section S, second sentence, replace by—

"A candidate must be a member of the Washington Academy of Sciences or a resident member of one of the Affiliated Societies and shall not have passed the 40th anniversary, etc. . . . "

The meeting was adjourned at 10:40 P.M.

C. L. GAZIN, *Secretary*

THE 1947 ACADEMY AWARDS FOR SCIENTIFIC ACHIEVEMENT

As encouragement to younger scientists the Washington Academy of Sciences makes three annual Awards for Scientific Achievement to members of the Academy or resident members of the affiliated societies—one in the Biological Sciences, one in the Engineering Sciences, and one in the Physical Sciences.

Only two awards were made for 1947. The winners were Robert DeWitt Huntoon, of the National Bureau of Standards, in the Physical Sciences; and Harry Warren Wells, of the Carnegie Institution of Washington, in the Engineering Sciences. The awards were made at the regular meeting of the Academy at the Cosmos Club on the evening of March 18, 1948. Dr. Huntoon's citation was "in recognition of his distinguished service in the advancement of electronics and its applications to other sciences and to modern ordnance." Mr. Wells's was "in recognition of his distinguished upper-air research and organization of a world-wide network of ionospheric stations."

ROBERT DEWITT HUNTOON

Dr. Huntoon was born at Waterloo, Iowa, on July 20, 1909. After obtaining his B.A. degree from Iowa State Teachers College in 1932, he began graduate work at the State University of Iowa, receiving his M.S. degree in 1935 and his Ph.D. in 1938. During this time he also served as graduate teaching assistant (1933–35) and research assistant in the University's department of physics (1935–38). Leaving Iowa, he became instructor in physics at New York University (1938–40), then research physicist with the Hygrade Sylvania Corporation (Sylvania Electric Products, Inc.) at Emporium, Pa. (1940–41), and in 1941 joined the staff of the National Bureau of Standards to work on electronic ordnance devices. In 1944–45 he served as expert consultant to the Office of the Secretary of War, but

returned to the Bureau to become chief of the Basic Research Section, Ordnance Development Division, and later chief of the Electronics Section. At present he is assistant chief of the Atomic Physics Division.

ROBERT DEWITT HUNTOON

In addition to the Academy Award, Dr. Huntoon is the recipient of two other distinguished recognitions of his abilities: A Naval Ordnance Development Award and a War Department Certificate of Appreciation, both in 1946. He is a member of the American Physical Society, the Philosophical Society of Washington, the Institute of Radio Engineers (senior member), Sigma Xi, and Kappa Delta Pi.

HARRY WARREN WELLS

Mr. Wells is a native of Washington, D. C., where he was born on January 13, 1907. He received the B.S. degree in electrical engineering in 1928 and the E.E. degree in 1937 from the University of Maryland. Between 1928 and 1932 he was associated with the Westinghouse Electric & Manufacturing Co., the All-American Malaysian Expedition to Borneo, Heintz & Kaufman, Ltd., and the Army Air Forces. He has been a member of the scientific staff of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, since 1932. His investigations, both here and abroad, have contributed materially to knowledge of the ionosphere, radio wave propagation, and related geophysical subjects.

Mr. Wells is a member of the Committee on Wave Propagation and Utilization of the

HARRY WARREN WELLS

Institute of Radio Engineers and is a senior member of that Institute. His other professional affiliations include the Washington Academy of Sciences, the American Geophysical Union, and the Philosophical Society of Washington.